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LEVEL II

QUALITY HORIZONS'
FINAL REPORT

VOLUME I

QUALITY HORIZONS' STUDY TEAM

15 NOVEMBER 1979

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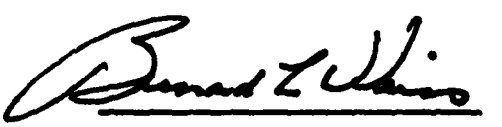
OBSERVATIONS AND RECOMMENDATIONS TO ENHANCE PRODUCT QUALITY IN THE OPERATIONAL ENVIRONMENT

PREPARED BY:
THE QUALITY HORIZONS' STUDY TEAM
WITH REPRESENTATIVES
FROM HQ AFSC, HQ AFCMD, ASD and SAMSO

THIS QUALITY HORIZONS' STUDY REPORT REFLECTS THE OBSERVATIONS, FINDINGS AND RECOMMENDATIONS OF THE MEMBERS OF THE QUALITY HORIZONS' STUDY TEAM. THE REPORT DOES NOT NECESSARILY REFLECT THE POSITION OF AIR FORCE SYSTEMS COMMAND WITH REGARD TO THE ISSUES RAISED OR RECOMMENDATIONS PRESENTED.

APPROVED:



BERNARD L. WEISS
COLONEL, USAF
STUDY DIRECTOR

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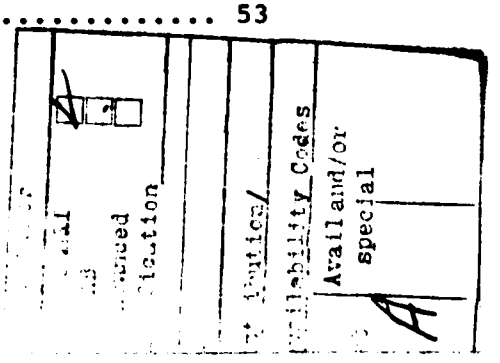

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I. EXECUTIVE SUMMARY

The Quality Horizons' Study was initiated by General Alton D. Slay, Commander, Air Force Systems Command, by letter dated 22 November 1978. The thrust of the study effort was to determine ways to enhance product quality in the operating environment. Study objectives were to evaluate the AFSC approach to quality assurance and identify changes with potential to: (i) improve end item quality in field use, (ii) make contractors more responsible for their products, (iii) make more effective use of resources, and (iv) apply appropriate commercial practices.

Major study efforts were started in January 1979 and completed in June 1979. Written progress reports were provided to General Slay throughout the study. Progress and final report briefings were presented to General Slay and his staff on 29 March 1979 and 1 June 1979, respectively. Prior to the final report briefing to AFSC/CC, the Product Division Commanders and the Commander of the Air Force Contract Management Division were briefed as to the team's observations and recommendations. Their concerns were included in the final report briefing and final report. The study team visited 66 selected governmental and industrial organizations in the United States and overseas. The following is a summary of the team's major observations:

(1) Attainment of field product quality is a function of the interest and priority placed on quality by top managers.

(2) Governmental and industrial organizations which have succeeded in obtaining high product quality levels, blend the assurance sciences into one high level organization which can act as a protagonist in causing tradeoff analyses and in assuring a disciplined integration of efforts to obtain product quality.

(3) Agreement exists that product assurance cannot be inspected into any product. Nevertheless, AFSC places more emphasis on conformance verification than attempting to influence product quality through design, process control and test planning early in the program life cycle.

(4) While various plans and programs have been implemented or proposed in DOD for reduced levels

of in-plant surveillance, program managers are generally reluctant to accept reduced in-plant Government quality assurance activities, especially conformance inspections.

(5) Commercial contracts are firm fixed price, with limited customer financing, and sole source follow-on buys are common with vendors that deliver a quality product at a reasonable price.

(6) In the commercial sector, warranties are generally offered only as a result of competitive pressures, such as in the commercial aircraft industry. Performance incentives and award fee provisions are almost never used in the commercial environment, either in the U.S. or overseas, nor do foreign governments employ them. Profits are their main incentive due to firm fixed pricing.

High levels of quality are obtained in the commercial sector where top management demands product quality or where competitive market pressures are such that the customer has an alternate source. General Slay, in Command Policy Letter 22, is on target with his drive for increased competition and use of firm fixed price contracts which adds impetus for enhanced product quality. Under firm fixed priced contracts, the full cost responsibility rests on the contractor's shoulders. The emphasis is on doing things right the first time.

The major recommendations of the Quality Horizons' Study Team are listed in summary form below. All recommendations are contained in the Action Plan (Appendix I) and discussed in Section V.

(1) AFSC must modify its current QUALITY assurance program to a PRODUCT assurance program to gain emphasis and attention to preventive efforts during design, development and test. AFSC's present program, while theoretically including preventive actions through a broad array of specialities, is heavily oriented toward in-plant conformance verification. The change in organizational concept and titles is necessary to reflect the increased emphasis on front end involvement by the requisite engineering and technical talents of the Product Divisions and AFCMD.

(2) In order to effectively implement the product assurance approach, it is recommended that all assurance disciplines, except manufacturing at AFCMD, be consolidated into one organizational element reporting

directly to the Commanders at all levels. This consolidation of skills is necessary to provide a critical mass of expertise and an organizational placement which will convert fragmented efforts toward product assurance to meaningful preventive actions and trade-offs.

(3) To motivate contractors to be more responsible for the quality of their products, the study team recommends selectively reducing the levels of in-plant conformance verification based upon a contractor's quality track record. A Minimum In-plant Surveillance (MIPS) program should be established where each contractor under AFPRO surveillance can make application for this reduced level of government surveillance. As the MIPS program proves successful, additional manpower can be reallocated to product assurance prevention efforts where greater returns from existing resources can be obtained.

(4) Positive actions must be taken to upgrade the training and education of the existing workforce and to provide for the orderly replacement of existing personnel through the establishment of a formalized three year intern program, geared to the skills necessary to perform product assurance in the aerospace community.

(5) Various recommendations are made in the area of contracting practices to support implementation and compliance with Policy Letter 22 and adopt, where feasible, existing commercial practices to enhance product quality. Specific recommendations cover the test of modified clauses which would restrict use of unilateral changes and modify procedures regarding point of final hardware acceptance. Other recommendations cover actions to reduce the level of Government financing of contracts, restrict progress payments, make greater use of award fee provisions and obtain authority to maintain two sources in production without a mobilization justification.

(6) A clear policy statement is required to support the use of contracting out to organizations (with hardware exclusion clauses) for selected product assurance functions requiring capabilities not available.

(7) The last group of recommendations emphasize the need for top management support to product assurance. A short, hard punching executive level training program is necessary to impart a sensitivity as to the benefits and risks of including or excluding product assurance considerations in Air Force programs. In addition, product assurance issues and actions should be made

part of various management and program reviews held within AFSC or at contractors' facilities. Providing product assurance visibility to managers will aid in enhancing product quality. Contractors sense Air Force priorities and react accordingly.

Improved product quality is obtainable for Air Force systems. The Quality Horizons' Team observed the results that management attention and investment have achieved in improving product quality in Japan and Europe. Similar results were observed in many commercial firms visited in the United States where product quality is a distinct customer requirement. Techniques and skills are available to obtain improved quality. They must be used early during the design and development process. The product assurance approach prevents deficiencies and can reduce the required in-plant defect detection and corrective action efforts. The impact of product assurance requirement trade-offs on field performance must be considered. With scarce resources, product assurance considerations may not always be supported. Nevertheless, decisions have to be made based upon predicted impacts, fund availability, performance requirements and delivery schedules. Product assurance, like other performance requirements, demands management attention and investment - "there is no free lunch."

II. STUDY REPORT

A. Study Approach Overview

Charter - The Quality Horizons Study was established by Alton D. Slay, General, USAF, Commander, Air Force Systems Command, by correspondence dated 22 November 1978, (Volume II, Section 1). The study directive was based on a plan developed by the AFSC Quality Assurance Office and approved by James W. Stansberry, Major General, USAF, DCS/Contracting and Manufacturing, (Volume II, Section 3). The study approach, (Volume II, Section 4) contains four main points:

1. Examine the concepts of contractor responsibility for end item quality and reduced Government in-plant presence and how these concepts could be implemented, managed and enforced in AFSC based on experience in various government, commercial and foreign settings. Consider programs for certifying contractor QA systems and personnel while assuring no degradation in end item quality.

2. Identify the type of contractual relationships which would provide strong positive or negative incentives that successfully place the responsibility for item quality with the contractor. Examine commercial practice for possible application in Air Force contracts.

3. Evaluate the qualifications of the AFSC QA work force and changes required in recruitment, training, education and assignment to strengthen the future work force.

4. Develop the proper QA organization structure and manning including the concept of a product assurance office, to implement changes resulting from the study.

It was assumed that there would be no increase in overall manpower that would result from recommendations contained in this study.

Team composition - Colonel R. C. Preston, Jr., Chief of Staff, HQ AFSC, was originally selected as the Study Director. However, prior to commencing the study, he was nominated for Brig Gen and reassigned. Col Bernard L. Weiss, Deputy for Contracting and Manufacturing, Aeronautical Systems Division, was named to replace Col Preston on 15 January 1979, (Volume II, Section 2). The ultimate team composition included:

Col Bernard L. Weiss
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Mr. Arthur A. Shannon
Deputy Director, Quality Assurance
Headquarters Air Force Contract Management Division
Mr. Shannon was Deputy Study Director

Mr. Donald W. Robinson
Director, Policy and Review
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Lt Col Michael M. McMillan
Chief, Aeronautical and Armament Division
Systems and Support Contracts Directorate
DCS/Contracting and Manufacturing, HQ AFSC

Lt Col Richard E. Tracey
Chief, Reliability and Quality Assurance Division
System Acquisition Management Support Directorate
ICBM Program Office
Space and Missile Systems Organization

Mr. Ira J. Epstein
Quality Assurance Engineer
Quality Assurance Office
DCS/Contracting and Manufacturing, HQ AFSC

Capt Raymond R. Honaker
Staff Quality Assurance Manager
Quality Assurance Division
Directorate of Manufacturing
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Capt John R. McNally
Manufacturing Staff Officer
Manufacturing Management Division
Directorate of Manufacturing
Deputy for Contracting and Manufacturing
Aeronautical Systems Division

Advisors to the study team included:

Capt C. B. Gresham, AFLC/JAN

AFSC Product Division Quality Assurance Directors

NSIA and AIA committees for Quality and Contracts

B. Study Approach - The team developed its assessment of the Command quality assurance program from the following sources:

1. A review of the results of previous studies with findings pertinent to the AFSC QA function.

2. Meetings and discussions with quality assurance professionals in government, industry, and professional organizations.

3. Briefings and discussions at each Product Division and AFCMD.

The team visited 66 government agencies and industrial firms in the United States, Japan, Germany, Denmark, Norway and Belgium. The industrial firms visited were engaged in work involving total commercial, total defense or a combination of the two. The government organizations visited included both DOD and civilian agencies. Each location visited (Tables 1 and 2) was provided a briefing (Appendix 2) to describe the intent of the visit and the reason for the AFSC study. The organizations visited usually provided a briefing on their view of quality assurance, their organization, and recommendations with regard to the team's study objectives. Following this, the team conducted an in-depth interview, concentrating on those unique aspects of the organization visited and innovations they had implemented or suggested for consideration.

Areas Examined - The team developed a questionnaire, (Volume II, Section 5) which was used during each interview to assure areas of consideration were not overlooked and to provide a more structured recording of their observations. The major areas of consideration were: organization/manning, education/training, quality-planning, quality measurement, subcontracting, contract requirements/warranties/incentives/guarantees, and field service. Summary highlights of the interviews are contained in Section IV, Study Observations. Details of each visit, such as completed questionnaires, copies of briefings and handouts provided are contained in separate trip folders for each visit.

Briefings Conducted - On 29 March 1979, General Slay and his staff were provided an interim briefing outlining the results of visits to that date and the principle observations. General Slay supported the briefing presented and highlighted the importance of the study effort. He offered no redirection. A copy of this briefing is contained in Volume II, Section 7.

Commanders of each of the AFSC Product Divisions (ADTC, ASD, ESD and SAMSO) and AFCMD were provided briefings on the results of the study. Their comments, (Volume II, Section 8) were considered in developing the final briefing to General Slay on 1 June (Volume II, Section 9).

Progress Reports - General Slay was provided bi-weekly progress reports, (Volume II, Section 6). The progress reports summarized the major observations made during each reporting period.

ORGANIZATIONS VISITED

(United States)

COMMERCIAL

MILITARY PRODUCTS*

Bendix	Honeywell

COMMERCIAL PRODUCTS

Western Electric	Bell Labs	RCA Avionics
Sears	Quasar	Gates Lear Jet

COMMERCIAL & MILITARY PRODUCTS*

Texas Instruments	Hughes	Northrop
Cleveland Pneumatic	Boeing	Douglas
General Electric (Aircraft Engine Group)	Beech	TRW
	Cessna	

GOVERNMENT

HQ USAF
Office of the Secretary of Defense (OSD)
HQ Defense Logistics Agency (DLA)
Electronic Systems Division (ESD)
Armament Development Test Center (ADTC)
Space & Missile Systems Organization (SAMSO)
Air Force Contract Management Division (AFCMD)
HQ Federal Aviation Administration (FAA)
National Aeronautics & Space Administration, Houston (NASA)
Federal Aviation Administration (NW Region)
Defense Contract Administration Services, Atlanta
HQ AFSC/SDD
Aeronautical Systems Division (ASD)
Naval Material Command (NAVMAT)
Naval Air Systems Command (NAVAIR)
US Army Development and Readiness Command (DARCOM)

OTHER

Airline Representatives:

Southwest	American	United

National Security Industrial Association (NSIA)
Aerospace Industries Association of America Inc (AIA)
Electronic Industries Association (EIA)
ARINC

*Included visit to CAS Office

TABLE 1

ORGANIZATIONS VISITED
(Overseas)

JAPAN

COMMERCIAL PRODUCTS	COMMERCIAL & MILITARY PRODUCTS
Ricoh Company	Nippon Electric
Nissan	Mitsubishi
Nippon Steel	

GOVERNMENT AGENCIES

US Embassy Mutual Defense Office
Central Procurement Office
Technical Research Development Office

OTHER

Union of Japanese Scientists & Engineers (JUSE)

GERMANY

COMMERCIAL & MILITARY PRODUCTS

LITEF (Litton Technische Werke)
MBB (Messerschmitt Bolkow - Blohm)

GOVERNMENT AGENCIES

Det 16/AFCMC
Federal Ministry of Defense

DENMARK

COMMERCIAL PRODUCTS	COMMERCIAL & MILITARY PRODUCTS
Bruel & Kjaer	Standard Electric

GOVERNMENT AGENCIES

US Embassy Office of Defense Cooperation
Ministry of Commerce
Royal Danish Air Force Air Material Command

NORWAY

COMMERCIAL & MILITARY PRODUCTS

NEBB (Norsk Elektrisk & Brown Boverl)
Kvaerner
Kongsberg KV

GOVERNMENT AGENCY

Defense Combined Material Agency (DCMA)

BELGIUM

COMMERCIAL & MILITARY PRODUCTS

MBLE (Manufacture Beige DeLampes Et De Materiel Electronique)

GOVERNMENT AGENCIES

Contract Administration Services Europe (CASEUR)
Ministry of Defense (MOD Belgium)

TABLE 2

III. CURRENT AFSC APPROACH

In order to set the stage for recommendations to enhance quality assurance functions in Air Force Systems Command, we must briefly review our current approach. This review covers the major organizations involved in quality assurance.

A. Laboratories

AFSC Laboratories are primarily involved in basic research and development. Product quality assurance is not normally an element of major concern either for in-house development work, research, exploratory system or equipment development contracts. If appropriate, contracts for research or exploratory development contain requirements for the contractor to establish and implement a quality assurance program tailored to fit the given situation. Checklists used by the laboratory to develop procurement requests contain an item associated with quality assurance, which serve to ensure that quality aspects of the pending procurement are considered. In general, however, there are no formalized procedures in the laboratories related to a quality assurance program for in-house work or for contracted efforts.

There are no quality assurance engineers, technicians, or managers assigned to the laboratories. However, there are laboratory engineering and technical personnel knowledgeable in the area of nondestructive testing (NDT) who are available and provide consultation and QA support to program offices. The Air Force Materials Laboratory (AFML) is the USAF focal point for developing new or advanced NDT equipment.

Quality assurance training courses, offered within the DOD, are available to laboratory personnel. However, lab personnel have generally not availed themselves of such training opportunities. Training on non-destructive inspection equipment and techniques is presented by AFML personnel to AFSC and AFLC personnel, on a request basis.

Typical laboratory contracts for research or exploratory development work result in final reports, analyses, or recommendations; not hardware. Where an item of hardware is required, it is usually one of a kind. The contractor generally has sole responsibility for the end item. In-process inspection, testing, or final acceptance, under a formal quality assurance program are not accomplished.

B. Product Divisions

Each AFSC Product Division has taken action to implement AFSCR 74-1, Quality Assurance Program, which requires the quality assurance function to be actively involved in all phases of the system acquisition process. Although approaches and effectiveness vary among divisions, each has assigned a Quality Assurance Manager (QAM) to its larger programs, and each has provided for some degree of staff support for the QA functional area. As a group, the QA leaders at each product division are supporting efforts of the command Quality Assurance Office (AFSC/PMN) to improve the effectiveness of QA through activities such as the "Quality 79" management objectives program and the preparation of guidebooks for QA management and for application and interpretation of MIL-STD-1520A, Corrective Action and Disposition System for Nonconforming Material, and MIL-STD-1535A, Supplier Quality Assurance Program Requirements. This group is also involved in the improvement of QA-related specifications, standards, and acquisition regulations. Through these activities the AFSC quality assurance community has been working cooperatively to increase the positive impact of QA disciplines on the acquisition process.

SAMSO has a centralized QA staff of 5 in the Directorate of Manufacturing and Quality Assurance within the Deputy for Contracting and Manufacturing. There are additional full-time and part-time QA Managers (QAMs) or points of contact in the program offices for a total of 2 full-time equivalents. SAMSO contracts with Aerospace Corporation for 31 product assurance personnel (6 QA, 11 Reliability and 14 Parts Control) and TRW Systems for 21 product assurance personnel (4 QA, 9 Reliability and 8 Parts Control). This supplemental support provides specialized skills to the SAMSO product assurance management and staffs. The ICBM Program Office, SAMSO's largest SPO, has located its QA function in the Acquisition Management and Systems Support Directorate. The QAM is part of the Reliability and Quality Assurance Division of that Directorate and is supported by the full-time TRW QA personnel included above.

The ADTC QA function is in the Manufacturing and Quality Assurance Directorate within the Deputy for Contracting and Manufacturing. There are 14 QA manager/engineer positions which support armament systems acquisition and 4 QA specialist positions

involved in administration of secondary delegations. ADTC also has 6 QA technicians in the Test Wing who perform technical surveillance of range operation services. The responsibility for reliability, maintainability, test, configuration management, program management and engineering is assigned to the Deputy for Armament Systems.

The ASD QA focal point is the Quality Assurance Division in the Directorate of Manufacturing within the Deputy for Contracting and Manufacturing. The QA Division is the responsible staff office for QA management using the ASD matrix management concept. The quality engineering function at ASD is matrixed out of the Engineering Specialities Division within the Deputy for Engineering. ASD has 29 full-time QA positions authorized, of which 8 are designated as QA Engineers (QAEs). In ASD, collocated QAM and QAE personnel work under the direction of the senior collocate, such as Chief of Manufacturing or Chief Engineer, and therefore are an integral part of the program organization. The staff offices in this arrangement provide resources, policy guidance, and assistance to collocated personnel.

At ESD, the quality assurance focal point is one individual located in the Systems Engineering Directorate within the Deputy for Technical Operations. A second full-time QA specialist is assigned as the QA manager for the E3A and E4 programs. Remaining QA activities are accomplished by part-time personnel.

C. AFCMD

The basic mission of AFCMD is to support Program Directors by performing the standard contract administration functions of DAR 1-406 and additional functions contained in Memorandums of Agreement per DAR 20-703. Historically, AFPRO activities have provided QA appraisals to the program office through their in-plant presence, control, and visibility. In the early 1970s, it became obvious to AFCMD management that many program problems which absorbed a great deal of problem-solving manhours and dollars were caused by basic deficiencies in contractor management systems. In an effort to do a better job with less resources, AFCMD embarked on a program to change the alignment of their mission so as to emphasize management systems evaluation.

The Contractor Management System Evaluation Program, CMSEP, treats contractor management as a system, and, in an orderly way, evaluates the system for existence, for adequacy, and for compliance. At each AFPRO, CMSEP is a continuous process of testing the management system and sampling its outputs. The program tasks which each AFPRO continues to perform in support of the Program Director thus become a part of the CMSEP continuous evaluation process.

CMSEP has affected the AFCMD quality assurance function in a number of ways. First, since CMSEP is oriented to prevention of problems, it changed the balance between QA appraisal effort and QA prevention effort. More manhours are directed at procedural issues and quality planning matters and less effort on direct inspection of products and processes. Secondly, CMSEP caused quality assurance responsibilities to be allocated to other functional AFPRO elements including Manufacturing, Subcontract Management, and Engineering. With this reallocation of responsibility, the QA element diminished in size and in stature. On the other hand, all AFPRO functions now have an active part to play in achieving QA objectives, and have a better appreciation for the QA requirements and their contribution to program success.

The current AFCMD QA work force strength is 1,184. This total includes all manpower positions in the QA function at the Headquarters and at the Detachments. Since 1968, AFCMD manpower has been reduced by 15% from 3,993 to 3,389, while the quality assurance work force has been reduced by 32% from 1,741 to 1,184. Of the total AFCMD reductions (604 manpower positions), 92.2% (557 manpower positions) were in the quality assurance function. This magnitude of reduction has caused AFCMD to move from a concept of individual defect detection to a systems survey approach with more reliance placed on the results of the contractor's inspection efforts.

The majority of the employees assigned to the quality assurance function do not have college degrees. Thirty percent of the employees have some college education (less than a Bachelor's degree) and 15% have a Bachelor's degree or higher. This mix of education is a direct reflection of the type of functions performed by the quality assurance specialists in the past.

Forty-two percent of AFCMD's effort, based on contract dollar value, is in support of non-AFSC contracts, principally NASA and the Navy. NASA procurement regulations require that they use the DOD component that has been assigned plant cognizance. DOD Instruction 5030.42, "Performance of Contract Administration Services and Contract Audit Services in Support of NASA Contracts", contains the NASA/DOD Agreement that DOD CAS personnel will accomplish Procurement Quality Assurance for NASA. This support is normally the direct inspection of product parameters deemed important by NASA. While there is a certain amount of benefit to NASA as a result of CMSEP, normally NASA desires only mandatory product inspection. When AFCMD has plant cognizance, it provides the same quality assurance program for Navy contracts as for USAF contracts.

D. HQ AFSC

The current AFSC quality assurance organization was established in October 1977 by Maj Gen Stansberry as a result of the Quality '77 Study. The Quality Assurance Office reports directly to the DCS/Contracting and Manufacturing who reports to the Commander, AFSC. The office is authorized five professional spaces and one clerical space. The current chief is a Lt Col (an 0-6 is authorized). The office is primarily responsible for establishing AFSC quality assurance policy. The policy is contained in AFSCR 74-1. The office operates primarily in a management by objectives mode. AFSC quality assurance objectives are published and distributed to all first level field AFSC quality assurance organizations. Field organizations are assigned actions to support AFSC objectives. Examples of ongoing efforts are: training, career development, software quality assurance, quality technology program (Q-TECH), quality assurance program for ranges and test centers, programs for laboratories and for base contracting, incorporating quality assurance requirements into appropriate regulations and handbooks and asserting pressures to increase quality assurance manning. The Quality Assurance Office has no responsibility for reliability, maintainability, configuration management, test or other functions which have a direct effect on product quality. These functions are assigned to other organizations in AFSC.

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IV. STUDY OBSERVATIONS

A. Organization/Manning

Organizations for quality vary considerably as do organizational titles. Titles range from Quality Control to Quality Assurance to Product Assurance to Product Effectiveness to Systems Effectiveness and others. The organizations varied depending upon customer requirements, product line and responsibilities considered important by management. For example, if customer requirements include reliability, there would be a reliability organization, often integrated with the quality organization. As the product line becomes more sophisticated, there are more quality engineers, reliability engineers and other professionals in the organization. As product liability, product criticality, cost, warranty provisions and customer expectations increase, organizations for field support increase.

One U.S. firm, in direct competition with Japanese industry in a high technology product line, has been able to capture and maintain a significant share of the market. They attribute much of their success to the synergistic effect of combining the assurance disciplines at the top management level. Similar successes, based on similar organizations, were observed in other U.S. commercial firms. There appears to be a trend throughout industry and the Government toward combining many of the functional disciplines into the same organization to take advantage of their related influences on product quality and reliability. Those industrial firms and Government agencies organized in this way felt that it provided a much better utilization of resources since the same individual could perform several related tasks that were previously fragmented among different functional disciplines. They also felt it resulted in a program-oriented attitude rather than the compartmentalized thinking that the old fragmented organizational structure encouraged.

The study team observed that no two AFSC Product Division organizations are organized the same. In fact, there is not even any similarity between the HQ AFSC organization and that of the Product Divisions. Consequently, the assurance discipline organizations receive guidance from a variety of HQ AFSC staff offices. This fragmentation contributes to the lack of a strong voice in making program decisions and hinders the development of a unified product assurance position

that would maximize program benefits. Figures 1 thru 5 show the organizational placement of those functional disciplines in the AFSC Product Divisions and AFCMD that are often included in an integrated organization such as product assurance. These Figures emphasize the multiple lines of communication that exist between HQ AFSC and the division levels.

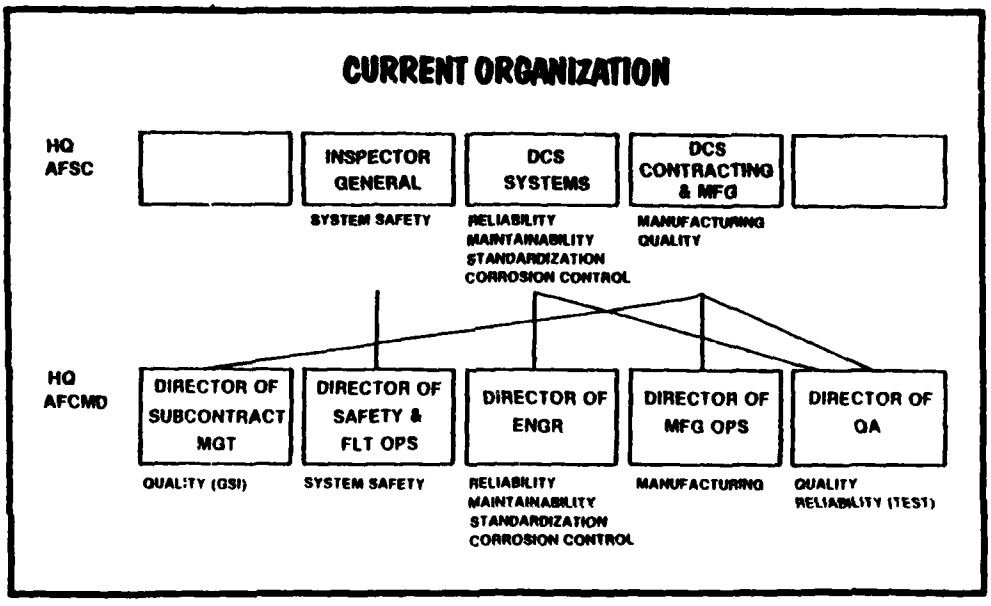

FIGURE 1

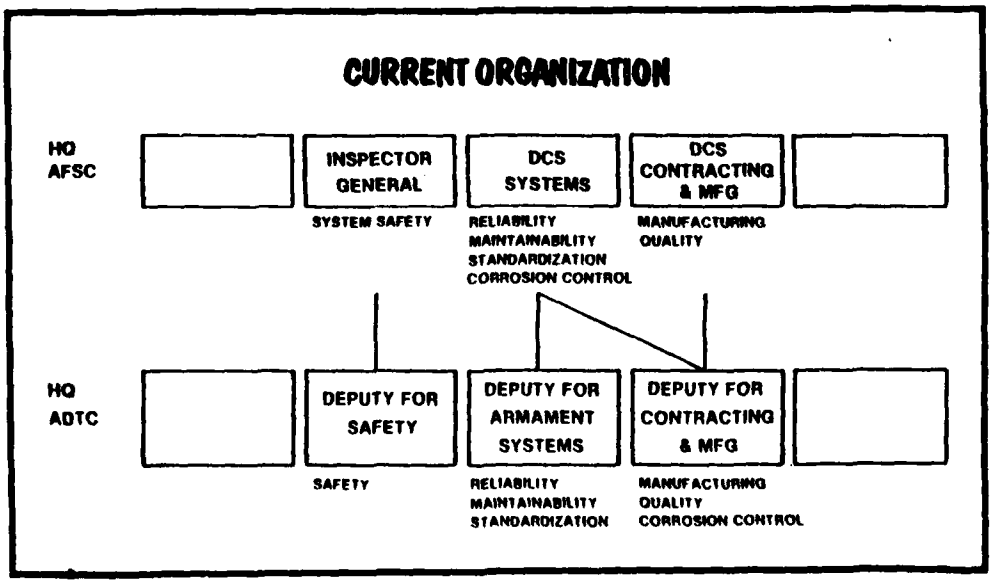

FIGURE 2

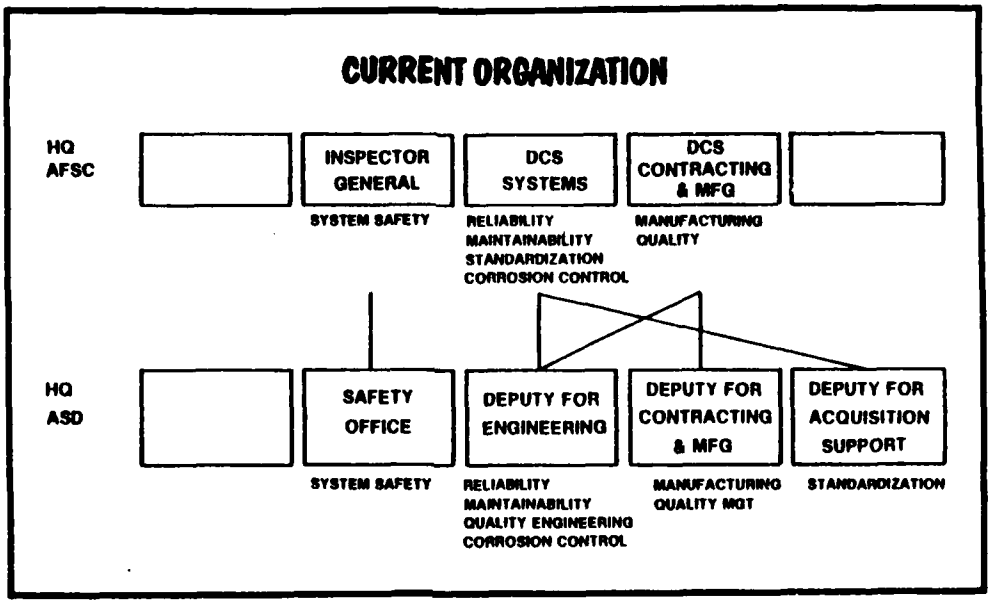

FIGURE 3

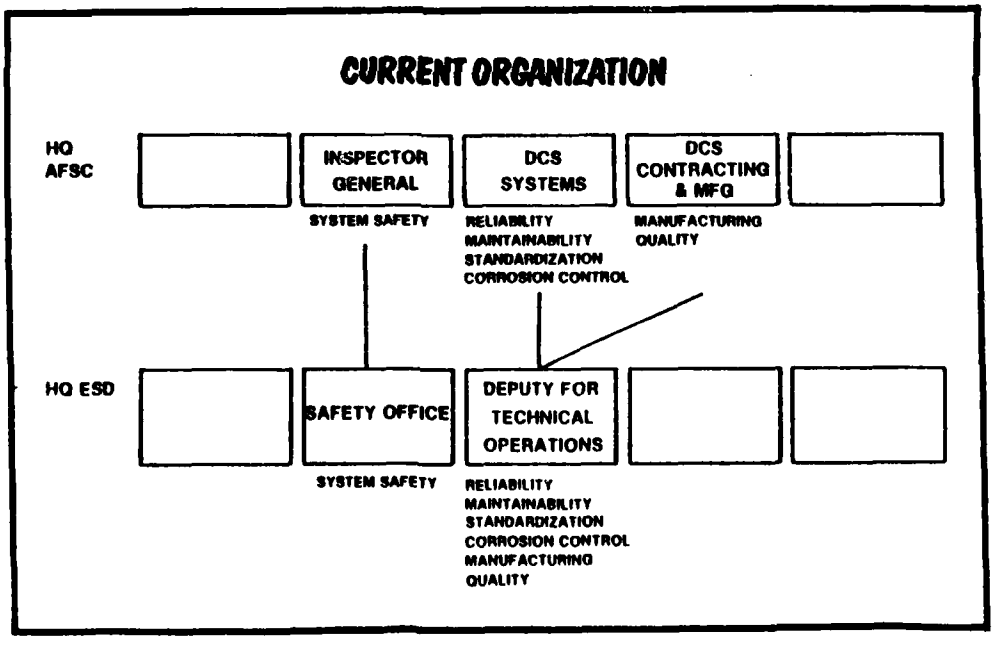

FIGURE 4

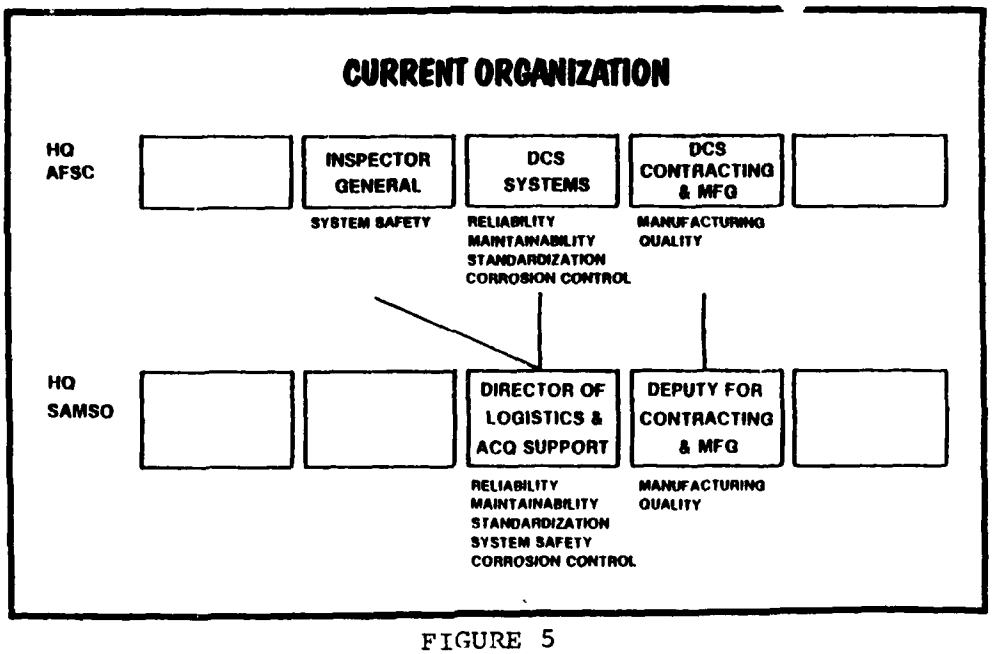

FIGURE 5

Table 3 shows the total number of personnel currently involved in product assurance disciplines in AFSC. These numbers represent those portions of the listed organizations that actually perform product assurance functions as defined in Section 5.

CURRENT PERSONNEL INVOLVED IN PRODUCT ASSURANCE

	HQ AFSC	ADTC	ASD	CMD	ESD	SAMSO
Manufacturing	31	24	149	70	50	22
Quality Assurance	6	14	29	1184	8	12
Engineering	7	18	55	190	13	23
System Safety	8	13	19	0	4	2
TOTALS	52	69	252	1444	75	59

GRAND TOTAL - 1951

TABLE 3

In most industrial organizations, where top management felt quality was important, quality management reported directly to the top operating official. In U.S. defense contractor organizations, quality is independent of the manufacturing organization and reports directly to the top operating official.

In Government agencies visited in the United States, the quality organizations and their level in the overall organization also varied. In the Naval Material Command (NAVMAT) (Figure 6), the Deputy Chief of NAVMAT for Reliability, Maintainability and Quality is a GS-16 and reports directly to the NAVMAT Commander (0-10). Each of the Naval Systems Commands below NAVMAT has a quality organization. At that level, the organizations are not uniform. A matrix concept is utilized. There are several GS-15s in the various Naval Systems Commands quality organizations. There are over 7,200 personnel in the Navy's quality career program, of which 6,200 are in NAVMAT.

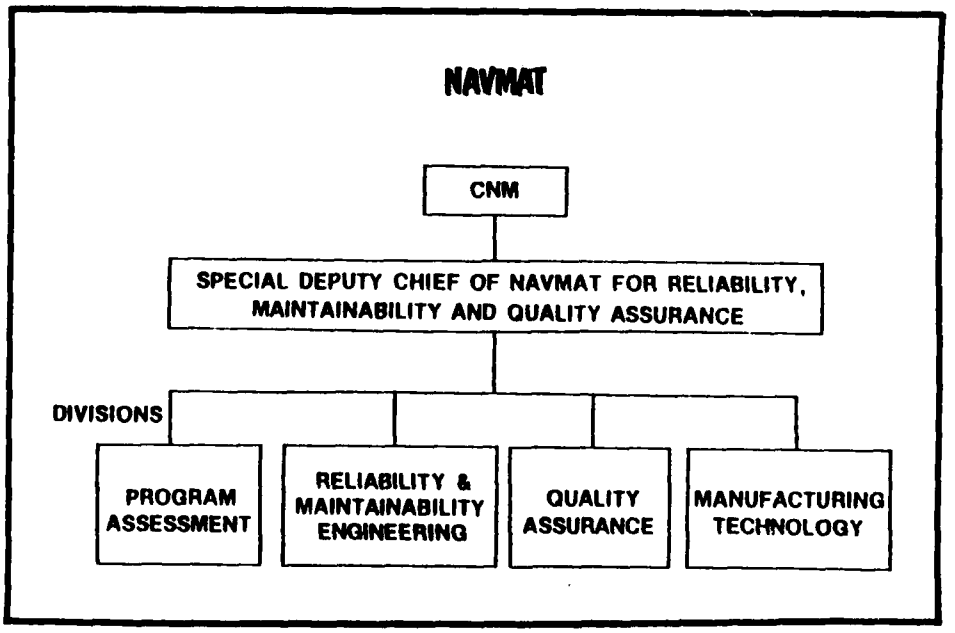

FIGURE 6

The Army has a strong and disciplined organization for quality. It is headed by a GS-16 who reports to the Commander (0-10) of the Development and Readiness Command (DARCOM) (Figure 7). Each subordinate product command has a quality assurance organization for development and another for readiness, generally headed by a GS-15. The quality assurance work force in DARCOM is over 5,600 people. They too, are matrix managed. DARCOM's product oriented Development Commands and Readiness Commands use the program manager concept like AFSC. There are, on the average, four to five quality assurance personnel assigned to each program office. The Chief of Quality Assurance in larger program offices is a GS-15. In smaller program offices, the position is generally a GS-14. Quality Assurance in DARCOM includes the reliability function. Quality is organized to assure/assess quality at all phases of the acquisition cycle including deployment.

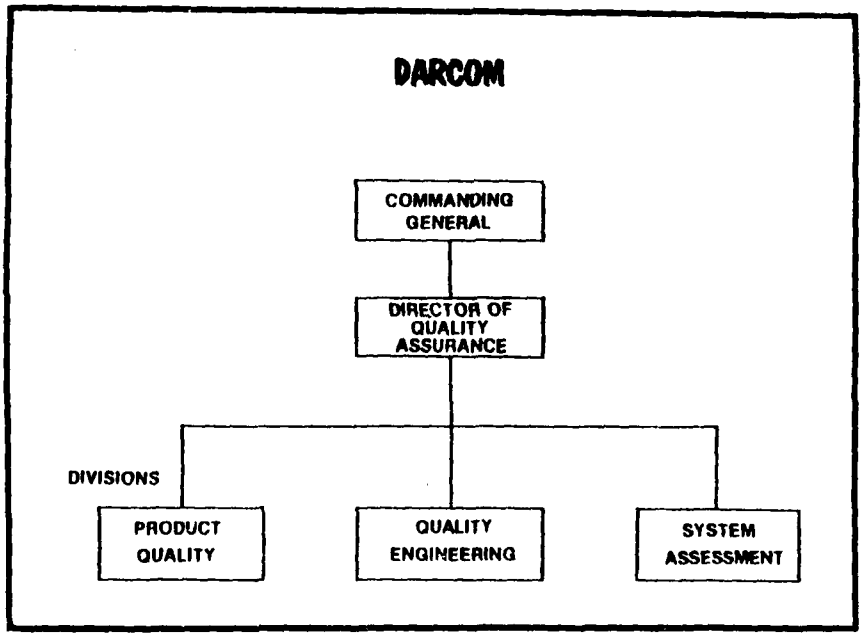

FIGURE 7

NASA's Johnson Space Center (JSC) has a quality organization which includes reliability and safety. There are 365 personnel in this organization which include 199 contractor support personnel. The Director of Safety, Reliability and Quality Assurance is a GS-17 and reports directly to the JSC Director. JSC is also matrix managed.

DCAS is organized somewhat differently since their function is solely contract administration. The quality assurance organization has about 6,500 people. The Executive Director of Quality Assurance is a Major General with a GS-16 Deputy. Regional Quality Assurance Directors are Colonels or GS-15s.

In contrast, HQ AFSC has a small quality assurance staff of five professionals headed by a Lt Col (Col position authorized). This staff is two organizational levels below the AFSC Commander. Most of the quality assurance personnel in AFSC are in AFCMD. The quality assurance organization in AFCMD is headed by a Lt Col (Col position authorized) who reports directly to the Commander. There are 1,184 quality personnel in AFCMD. The grade level of the AFPRO Quality Assurance Division Chiefs is GS-13 or GS-14. In all AFSC Product Divisions, except ESD, the quality organization is three levels below the Commander reporting to the Deputy for Contracting and Manufacturing. At ESD, quality assurance is also three levels below the Commander but under the Deputy for Technical Operations. Quality assurance manning authorized in program offices and product division staffs is: SAMSO - 8; ASD - 29; ADTC - 14; and ESD - 5. ASD and ADTC are matrix managed. The typical grade of a quality assurance manager assigned to a major program office is a GS-12/Captain. Some program offices do not have full-time quality assurance personnel assigned. The top quality assurance individual in the Product Divisions is a GS-13 or GS-14.

There appears to be a direct correlation between the influence of the quality assurance organization on management/program decisions and the grade of the quality assurance individual and his level in the organization. In U.S. companies, quality considerations are voiced; however, the final decision is usually a matter of negotiation and trade-off between cost and schedule. In Europe, quality appeared to be more influential and would normally not be sacrificed for schedule considerations. In Japan, quality factors normally dominated management decisions. The Japanese often sacrifice schedule and cost to attain high quality.

Quality assurance in the Army and NASA have an independent and equal voice with other functional organizations in program decisions. In AFSC, the QA organizations are normally too low in the overall organization to be influential. Quality assurance has neither an equal nor independent voice in program decisions because of their low organizational placement at the branch level (occasionally division level).

Although the QA capability in product divisions has been increasing over the past two years, it is not at a level sufficient to ensure that acquisition strategies and requirements trade-offs which generate program quality risk are given appropriate consideration prior to program decisions. Contributing to this are a lack of resources - both numbers and capabilities, the organizational location, and program management attitudes towards quality assurance.

Table 4 shows the typical quality assurance staffing of the various locations visited. Table 5 indicates how U.S. and foreign governments are manned in contract administration organizations to perform the quality assurance function. Tables 6 and 7 summarizes the organizational placement and grade levels of quality assurance organization in U.S. and foreign government agencies.

QA STAFFING

U.S. CONTRACTORS

GENERALLY AROUND 10% OF WORKFORCE
- INSPECTION AND TEST
LESS THAN 1% FOR SUBCONTRACTING

U.S. GOVERNMENT AGENCIES

APPROXIMATELY 10% OF CONTRACTOR's QA STAFFING
APPROXIMATELY 35% OF CAS STAFFING - ALL CIVILIAN
PRODUCT DIVISION VERY LIMITED (LESS THAN 1%)
- OFTEN ADDITIONAL DUTY

FOREIGN CONTRACTORS

APPROXIMATELY 10% OF WORKFORCE
- INSPECTION AND TEST

FOREIGN GOVERNMENT AGENCIES

APPROXIMATELY 10% OF CONTRACTOR's QA STAFFING
FROM 25% TO 100% OF CAS STAFFING
MULTIPLE RESPONSIBILITIES
SOME ARE ALL MILITARY

TABLE 4

DEFENSE QUALITY ASSURANCE STAFFING
(PERCENT OF CAS PERSONNEL)

U.S. (DCAS, AFPRO, NAVPRO)	35% (ALL CIVILIAN)
JAPAN (CPO)	40% (MOSTLY MILITARY)
GERMANY (BWB)	25% (ALL CIVILIAN)
DENMARK (AMC)	100%* (ALL MILITARY)
NORWAY (DCMA)	53% (ALL CIVILIAN)
BELGIUM (BAF/CAS)	100%* (ALL MILITARY)

*FIELD PERSONNEL PERFORM MULTIPLE FUNCTIONS

NOTE: AFSC PRODUCT DIVISIONS - LESS THAN 1% OF TOTAL WORKFORCE

TABLE 5

QUALITY ASSURANCE ORGANIZATIONAL PLACEMENT

UNITED STATES	LEVELS REMOVED FROM TOP MANAGER	COMPARABLE GRADE
HQ AFSC	TWO	COL
PRODUCT DIVISIONS (STAFF)	THREE	LT COL/GS-14
SPOs (ADDITIONAL DUTY)	TWO TO FOUR	CAPT/GS-12
CMD	ONE	COL
DCAS	ONE	MAJ GEN
ARMY	ONE	GS-16
NASA/JSC	ONE	GS-17
NAVY	ONE	GS-16

TABLE 6

QUALITY ASSURANCE ORGANIZATIONAL PLACEMENT

OVERSEAS	LEVELS REMOVED FROM TOP MANAGER	COMPARABLE GRADE
JAPAN (CPO)	ONE	SUPERGRADE
GERMANY (MOD)	FOUR	SUPERGRADE
DENMARK (AMC)	TWO	GS-14
NORWAY (DCMA)	ONE	GS-14
BELGIUM (BAF/CAS)	ONE	COL

TABLE 7

B. Quality Planning

It was observed that quality planning for commercial products begins by developing design criteria which is often published in company handbooks or procedures manuals which supplement industry standards. These efforts reflect experiences, lessons learned and proven techniques for assuring the inherent reliability and quality of the design. A significant aspect of this early involvement for design assurance is the use of a parts, materials and processes (PMP) standardization and control program. The more complex and critical the product, the more disciplined the use of PMP tools and techniques such as derating, parts application review, etc. A rational application (tailoring) of these tools is used and is based on program requirements as needed to support a cost effective program and the business strategy approach selected.

One commercial firm was able to reduce the number of rejects during the manufacture of its product from twice per item to less than 10 rejections per 100 items manufactured. They did this by management demanding a disciplined approach to quality planning. For example, the parts count was significantly reduced; derating criteria used; parts, subassemblies and assemblies screened and tested at each level; and labor intensive operations automated.

AFSC organizations generally do not have as disciplined an approach to assuring design quality. One notable exception is SAMSO, who relies on contracted support in this area. SAMSO feels very strongly that an effective PMP standardization and control program contributes more to product reliability than any other factor. They contractually impose quality planning factors such as derating criteria, parts application reviews, critical item and baseline controls. Even then their experience has shown that extensive monitoring and review of the contractor's efforts in these areas are required to prevent catastrophic problems. Through their close technical involvement with the contractors they are able to minimize cost, schedule and performance impacts. SAMSO's efforts in this area closely parallel the study team's observations of successful industrial firms producing comparably complex equipment. SAMSO as well as many commercial firms have experienced serious quality and reliability problems when the application of these tools and techniques has been lax or omitted, e.g., the Minuteman weld problem, TITAN booster failure, etc.

The other AFSC Product Divisions have not tended to impose these same contractual provisions, nor do they have the same expertise, e.g. parts engineers to develop or monitor their contractors' performance in these areas. Thus, they are forced to rely upon contractors to develop their own programs, design criteria, et cetera. Even then the program offices and CAOs are limited in their ability to monitor the contractor's performance in achieving these goals (not requirements) due to the lack of skilled manpower in these disciplines.

An often neglected quality planning function in AFSC has been the early involvement of quality engineers. Quality engineers influence design by assuring that the design accurately reflects the requirements, that lessons learned have been incorporated, that the design is repeatedly producible, and that meaningful inspections and tests are both possible and planned. Many companies, expecially the Japanese, perform these tasks and feel they provide a very cost effective defect prevention function.

Another important aspect in assuring the reliability and quality level of the product is to freeze the baseline when the design has been proven. After the baseline is established any changes can be completely analyzed or hardware retested to determine possible impacts on quality and reliability. During initial design analysis, contractors in the commercial sphere thoroughly evaluate vendor designs to determine the level of involvement and controls that will be needed to assure vendor performance. AFSC program offices often are not manned with sufficient or trained personnel to perform this effort.

In the commercial sector, firms tend to rely on evolutionary product improvements. Quantum changes generally occur only when technology advances have been proven. Product improvements are generally made to correct specific problems in the design or manufacturing processes, and the impact of these changes on reliability and quality are evaluated. Extensive preproduction testing is performed to assure that the design is producible and will perform as intented in the field environment.

Whenever specific product quality and reliability levels are required by the customer, verification testing is considered almost sacred. Only by such testing at all levels; i.e., part, subassembly, subsystem and system level, can a manufacturer have confidence

that the design will perform as intended. They recognize that design is an iterative process and seldom if ever will they produce a perfect design the first time even though they incorporate all currently known techniques. Unexpected problems can occur and may not be detected until the item reaches service. Thus, every attempt is made to subject the design to the anticipated worst case stresses to promote test failures. These failures are then analyzed to determine the cause so that preventive actions such as redesign, derating, circuit protection, etc., can be taken. Successful commercial organizations have found that numerous field failures are the direct result of failing to perform these vital functions adequately. Therefore, the product does not enter production until the manufacturer is confident that it is suitable and reliable.

In contrast, because of operational requirements, AFSC tends to push state-of-the-art advances in many areas simultaneously. Not only does AFSC require and support significant advances in performance with each new product, but tries to use the most advanced technologies and materials in manufacturing these products. As a result of these simultaneous learning curves, problems not only in performance and producibility occur, but major deterrents to quality are introduced. First, failure modes are introduced by not having fully matured the manufacturing process or by not understanding the problems such a process introduces. Thus, these failure modes are not recognized until equipment starts failing in the field. Problems in perfecting these new techniques and materials cause schedule delays and cost impacts which often result in cancelling the preproduction testing that could have identified these problems. The irony is that when these inherent problems are not identified and eliminated early, then the schedule and cost impacts tend to be even greater. Such schedule and cost impacts further encourage shortcuts and the introduction of even more problems, and the vicious circle continues. Thus, the more a new product advances technology and performance, the greater the need for the application of product assurance principles and techniques, yet the more likely they will not be used due to cost and schedule considerations.

Directly related to quality planning is accomplishment of the various program technical and management reviews. Those companies and government organizations that have been most successful have placed heavy emphasis on these efforts. Industry performs extensive analyses

of their manufacturing capabilities to assure that these capabilities are compatible with the requirements. They strive to balance the inherent capabilities and requirements by either improving the capability or reducing the requirements to an achievable level to assure that risks have been minimized. Program management is kept apprised of the evaluation results from which they can make program decisions based on risk assesments. Also included in their manufacturing capability and design analyses are the identification of critical aspects of manufacturing processes and procedures. These critical features either receive additional design analyses or controls are developed to assure that the manufacturing process will consistently result in a conforming product. This same attention is given to those aspects determined to be cost drivers. Inspection points including mandatory requirements are also determined during these analyses. Although all AFSC programs have similar reviews, such as critical design and production readiness, they are often performed by untrained and inexperienced personnel and in an undisciplined manner.

One aspect that is peculiar to the AFSC organization is the interface between the product divisions and the contract administration organizations (CAOs). Manpower limitations and organizational parochialism have often prevented the program offices and CAOs from developing a full and complete mutual understanding of the contract requirements, interrelationships, and a detailed and specific memorandum of agreement. Thus, CAOs often do not realize the program office's requirements or cannot support them with either skills or manning resources by the time these requirements are finally known. The program offices likewise are unaware of the unique capabilities of the supporting contract administration offices. Consequently, each organization independently works its own problems rather than mutually developing a team spirit in support of the program. Effective communications can be hindered and the contractor could end up receiving conflicting guidance or direction. Directly related to this is the unjustified establishment of mandatory product inspection requirements. These are often imposed by the program offices without any coordination with the CAOs. This could result in requiring needless inspections, omission of important requirements, or the inability to participate in various design reviews due to manpower limitations.

As seen in the commercial sector, industry's overall emphasis in the design area is on early failure analysis and defect prevention. AFSC programs invariably end up in a defect detection mode. The only way to avoid this is by early involvement by skilled quality, reliability, parts, etc., personnel concerned with product assurance requirements that will satisfy user's needs. These people must assure that the proper tools and techniques have been effectively and efficiently tailored and incorporated into the contract. This effort and the subsequent monitoring of the contractor's performance requires an appropriate level of manning and funding. Failure to assure an adequate level of manning and proper training invariably results in a reactive mode of problem tracking rather than failure prevention.

C. Quality Measurement

Measurement of quality begins by determining the contractor's quality of design, his capability to produce the product as specified and the effectiveness of his quality assurance program to assure conformance. Industrial firms engaged in development of commercial products tend to concentrate on these functions with their suppliers, recognizing that a vendor's capability and expertise truly determine the end product quality, reliability, schedule adherence and product cost. Their evaluation of a vendor is an in-depth, in-plant analysis by a team of specialists skilled in this function. They evaluate the vendor's total capability for producing and controlling the product's conformance to the requirements. They also consider a vendor's past performance as a strong indication of how he will perform on future contracts. Industry tends to select the best performers even though they may not be the lowest in initial cost.

AFSC has tended to place more emphasis on the lowest cost proposal due to the potential for protests, although more emphasis is being placed on past performance criteria of late. AFSC evaluations of a contractor's capability, quality assurance system and quality management are often performed only by evaluating the contractor's Quality Assurance Program Plan during source selection. Often the leverage to incorporate needed changes to the contractor's system is lost because these problems are not detected while still in a competitive environment. This results from a failure to fully evaluate the actual system because of a lack

of skilled personnel to perform the evaluation. After contract award, such changes are difficult to implement even though the contractor's system is obviously deficient and the change will result in improved quality and contractor efficiency.

Industry measurement of quality in the commercial market area is achieved in many ways. Vendor's rejection rates are tracked, i.e., incoming inspection, failures during assembly, costs of rejects, etc. They also measure the product's performance in the field (e.g., maintenance delays, aborts, in-flight shutdown, warranty returns, spares usage rates, etc.). These problems are not only analyzed for cause and failure trends, but they are also fed back to the vendor and corrective action is required.

In AFSC there is no primary system or responsible organization for collecting quality data. The CAOs are responsible for reviewing yield rates, excessive reworks, etc. and can identify the need for corrective action, yet the program office usually retains the authority to direct the contractor to make changes. Even if the CAOs provide the program office with visibility as to pre-acceptance quality performance levels, the information is generally untimely for corrective action. Field quality data is collected under several different and unrelated systems by different organizations. Quality deficiency reports are completed by the users on field equipment and submitted to the appropriate Air Logistics Center which usually does not have the authority to direct the contractor to do a failure analysis or take corrective action. During RDT&E, these deficiency reports are submitted to the program offices, but not necessarily to the CAOs. Spares usage rate reporting is also the responsibility of AFLC. Post acceptance aging and surveillance as well as reliability data are generally the responsibility of the program office.

There are significant differences between the way industry and the government deal with their suppliers who are having problems. Both send in teams to work the problems with the manufacturer. Industry tends to emphasize problems and their performance requirements, whereas the Government tends to direct how to resolve the problem and how to achieve the performance. Industry feels this causes unnecessary costs, denies them design latitude, relieves them of responsibility and makes the Government a direct party to any subsequent problems. Many government personnel feel that

this is a more economical approach, especially on cost type contracts in that lessons learned can be incorporated and standardization benefits realized. Both positions have some merit. Of major interest is the difference in the manner in which problems are worked by these two different approaches. In the commercial environment, industry seems to accept the fact that unforeseen difficulties may arise and that omissions and errors will be made. Therefore, they join forces to resolve the problem and prevent recurrence. The vendor is motivated to be cooperative in order to retain his market with the prime and the prime is motivated to retain a capable and experienced vendor. Their objectives are to assure customer satisfaction and make a profit.

Several industrial firms felt that the atmosphere in the DOD environment with respect to joint government-contractor problem resolution seems to be adversary. Each party seems more concerned with establishing blame and liability than achieving the proper problem resolution. This adversarial relationship is created in part by a success-oriented attitude and unrealistic expectations that do not recognize or allow for cost or reliability growth.

Since commercial enterprises often assume responsibility for product quality in the field environments through warranties, customer expectations, or product liability, they develop whatever data system is required to fulfill these needs. Their data systems range from sampling surveys to complete traceability depending on product complexity and the information required to make management decisions.

A common complaint heard from all sectors is that AFM 66-1, Maintenance Management, and T.O. 00-35D-54, USAF Material Deficiency Reporting System, data is inadequate for problem detection or corrective action. This results from the data not being accurate or timely; nor was it intended for that use, e.g., AFM 66-1 data is for maintenance management. Some organizations have augmented these data systems to obtain specific data needed on critical systems and subsystems. When taken in the aggregate, it appears that the AF data systems are generally as good as those observed in industry considering that both must tailor existing systems to their needs. AFSC data use is restrained, however, by the fragmented collection systems used and the absence of a centralized focal point for all data. Thus, no one organization appears to use all the data actually available to it.

The exceptions are when specific data requirements have demanded total tracking and management is willing to fund this additional effort. Two specific cases where AFSC does not appear to take full advantage of the data available are: contractor data and trend analyses are often not provided to the program offices, nor are they always evaluated by the CAOs; CMSEP generates a wealth of valuable information but this information is generally not provided to the program offices unless the condition has resulted in a cost and/or schedule impact. Prior knowledge of contractor trends could permit preventive actions or better planning by the program offices. This lack of information flow tends to be detrimental to a teamwork approach. If the program office has not been kept apprised of potential problems and the CAO's handling of them, then they tend to overreact when advised of the cost and/or schedule impacts or when they uncover the problem themselves. Conversely, when kept properly informed as to CAO actions, the program office's confidence in the CAO is generally better and thus more conducive to mutual problem resolution rather than assigning blame. Likewise, CAO positions with the contractor are often overridden by the program office, e.g., a demand for corrective action or refusal to accept a nonconforming article. These program office decisions may be correct; however, if the CAO is not a party to the decision process or kept apprised of other factors influencing the decision, then animosity and frustration are created.

In the commercial environment, industry makes extensive use of field technical representatives for data feedback. This is particularly true during the preproduction testing, field testing and early deployment stages so that accurate and timely feedback is available for product evaluations, improvements and accelerating of product maturity. AFSC has successfully used contractor technical representatives for this purpose in some instances. However, when the AF does not have contractor personnel perform this vital function, there is a definite deficiency in our normal data system and neither AFSC nor the contractor gets adequate failure data for use in determining timely or necessary corrective actions nor for reliability or quality measurements.

Industry management generally requires quality and reliability reports to be made to them in great detail so that they are able to continually assess their company's and vendor's quality performance and make trade-off decisions based on risk and cost analyses.

Air Force managers are generally interested in hearing about quality only on an exception basis, i.e., whenever there is a quality problem that impacts cost, schedule or performance. Reliability tends to be of a little more interest in that higher headquarters requirements demand reporting this factor, but only with respect to whether the goals have been attained and seldom for program decisions.

An area of quality measurement that was criticized by both industry and government as being deficient was that of automated test and inspection equipment. Many advances are being made in computer controlled manufacturing techniques and technical processes. However, the conformance verification of the products manufactured by these methods is often more time consuming and less sophisticated than their manufacture. Both industry and the government are faced with a cost dilemma in this area. Both appreciate the value to be received in developing automated or improved test and inspection equipment. However, the defense industry has no incentive to fund such research since the average historical inspection costs are normally allowed as a percent of direct manufacturing labor costs on new proposals. Also, the uncertainty of new government business precludes assurance of repayment of such major investments. In addition the government has several problems related to this issue. There is often a lack of awareness of the specific needs or likelihood of achieving the technology needed. There is also a general reluctance to fund research for equipment in light of the competing pressures for RDT&E funds more directly related to mission requirements. Thus, it appears that the government must motivate industry and participate with industry in these development efforts by providing seed money for such programs. In the long run, such capital investments will enhance product quality and improve inspection productivity, thus reducing acquisition and life cycle costs.

D. Education/Training

U.S. industry generally provides work related technical training to their employees. Equipment and system training is also available. Training in management and supervisory disciplines is not as readily available. Career development training is rare. College tuition assistance programs are generally provided for white collar workers. Some companies are reluctant to provide extensive training due to high personnel turnover rates.

All types of training are generally available and required in Japanese industry. New employees generally received extensive training. One year of technical training is common with emphasis on quality assurance. All company employees normally receive some training in the quality discipline regardless of their position or functional assignment. Training in quality is also provided to top managers. Training in Japan is considered to be a normal and necessary part of doing business and a good investment. Life-time employment, common in large Japanese companies, is an incentive to provide training.

Training and training programs in the U.S. military services and agencies range from extensive to almost non-existent. GSC falls into the latter category. The Defense Contract Administration Service (DCAS) has an extensive training program. In addition to the training that is available from DOD schools (e.g. AMETA), DCAS has two excellent quality assurance training programs. One is an individual certification program whereby quality assurance specialists are certified in one or more commodity areas. Not satisfied with the availability of courses from DOD schools, DCAS has developed an in-house capability to provide 37 courses on-site. Many of these courses were developed by DCAS. Qualified instructors are trained in each regional office and many sub-offices. In FY78 alone, DCAS taught 432 in-house courses and trained 4,741 students. About 78% of all DCAS quality assurance specialists are certified in one or more commodity areas. The second DCAS training program is a formal intern program. This program provides a continual input of well-qualified, motivated, high potential personnel to fill various quality assurance positions as they become vacant. The program is designed to output staff specialists, in-plant specialists, quality engineers and safety specialists. The intern program is three years in length and consists of both classroom and on-the-job training. The program costs about $57,000 per intern which includes salary, travel and moving expenses for the three years. Formal training is mostly provided by AMETA. DCAS inputs about 60 interns a year.

The Army has three quality assurance intern programs: one for quality assurance specialists, one for quality engineers and one for ammunition specialists. The Army's programs are the oldest in DOD. The Army graduates about 60 quality assurance specialists and quality engineers each year. These programs are also three years

in length and consist of classroom and on-the-job rotational training. The specialist and engineering program classroom training is provided by the Army's own school, AMETA. These programs are similar to the DCAS program but tailored to the Army's needs.

The Navy also has a quality intern program. It is for quality engineers only. It, too, is three years in duration and consists of six months of classroom training and two and a half years of on-the-job training at several Navy activities. The Navy program is the newest of all the intern programs. They input about 25 engineers each year. The unique feature of this program is that most of the training effort is accomplished by contractors. NAVMAT developed training outlines tailored to their needs and contracted for course development, course materials and instructors.

AFSC has neither an intern program nor a formal training program. Quality assurance training in AFSC is obtained by requesting training allocations through the AFSC personnel office. Training spaces obtained this way are few and far between. The Hq AFSC Quality Assurance Office has been attempting to establish a quality engineering intern program for over a year. Lack of manpower spaces have frustrated this attempt. As a result there is very little quality assurance training in AFSC.

There is an AFSC intern program in the Contracting and Manufacturing organization known as Copper Cap. These intern spaces are restricted to contracting and manufacturing functions. Although quality assurance in AFSC is generally a part of the Contracting and Manufacturing organizations, no spaces have been allocated to quality assurance interns.

The educational level of workers in quality assurance organizations in industrial firms varies considerably. This variation is generally related to product complexity and criticality. The inspection work force is generally comprised of technicians and mechanics. As complexity and criticality increase, quality engineers, reliability engineers, statisticians and other professionals are added to the quality organization. In U.S. commercial firms manufacturing sophisticated equipment, professionals make up as much as 25% of the quality assurance organization. In some U.S. firms producing defense or space hardware, professionals comprise as much as 40% of the quality assurance work force. These firms are producing some of the most

complex and sophisticated equipment in the world. The AFPRO quality assurance work force is responsible for monitoring the efforts of the contractors' work force and for assuring compliance with contract technical requirements. The AFPRO quality assurance work force includes about 15% professionals. (24% of all AFCMD civilians have college degrees.) Some of the defense contractors felt that the difference in professionalism between the AFPRO work force and their industrial counterparts contributes to the adversary relationship which often exists. They expressed concern that untrained CAO personnel are evaluating the efforts of their highly-skilled and technical work force. Since some CAO personnel are unable to make meaningful findings due to their lack of technical expertise, contractors allege that they sometimes resort to being highly critical but often in insignificant areas. This becomes a source of severe irritation to the contractor's personnel and often results in needless costs. Figure 8 displays the percent of college graduates in the quality assurance work force in the various activities and countries visited.

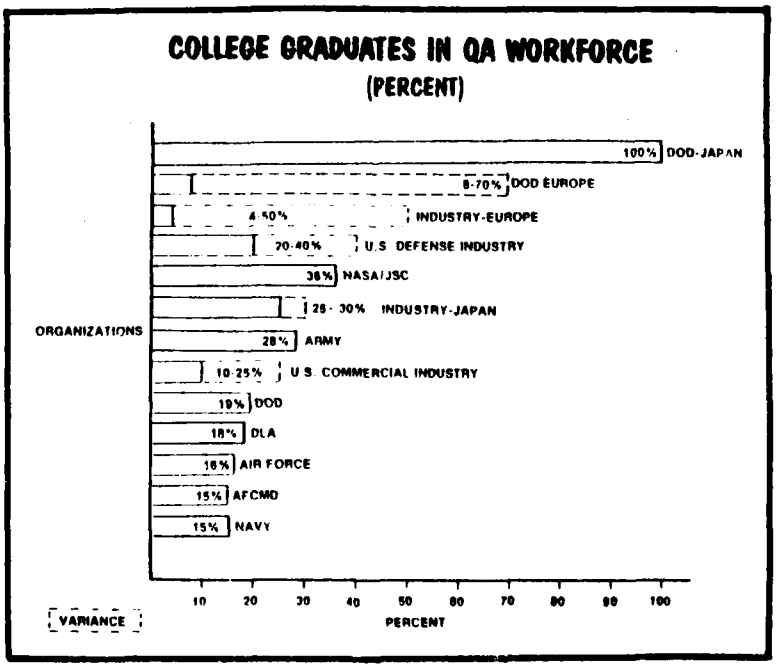

FIGURE 8

E. Contract/Subcontract/Warranty Arrangement

The Quality Horizons study team observed almost as many different "commercial practices" as commercial firms. Many of the different techniques appeared to be simply variations on a theme, however, and there are a number of observations that can be made and conclusions drawn.

First of all, commercial contracting arrangements are mostly firm fixed price and are negotiated before work commences, except for off-the-shelf items. Commercial firms use redeterminable contracts on occasion, where new development or a new product is involved, or even where quantities are uncertain making firm pricing difficult. But incentive arrangements in the commercial environment are the exception, not the rule, both in the United States and in the other countries visited by the Quality Horizons Team.

Commercial firms are able to deal firm fixed price, even on relatively complex items, for many reasons. Some of the most important are competition, vendor specification control, no "changes" clause, commercial pricing techniques, and the market place in general. They base their requirements on current technology, and take advantage of advances in the state-of-the-art only after they are proven; thus technical risk is generally low.

Competition is a strong driver when a vendor is to be chosen for a new program because vendors know that, for the most part, once they have the business, they will keep it. In almost all cases, commercial firms stay with a vendor once the vendor has produced a quality product. When a problem arises, the company and the vendor work together to try to resolve it. This is true throughout the United States and Europe, and is especially true in Japan. When large production quantities are involved, companies will dual or even triple source and maintain continuing competition that way. Even in those cases, vendors perceive the commercial business base as more stable than the Government's. One major consumer goods firm in the U.S. expressed extreme reluctance to change vendors. They stated that their success was first and foremost a result of long term relationships with their suppliers, and emphasized the difficulty and expense of introducing a new vendor to their requirements and business methods.

Specification control by the manufacturer is an important aspect of the commercial business environment. Performance specifications are called out, with the "how to" left to the vendor. The performance requirements are generally well defined and even if it is found that customer demands are different than expected, changes are controlled by the manufacturer. Firms will accept customer specified equipment, but may disclaim any responsibility for that equipment. In the case of consumer goods, customer satisfaction is more important than specification compliance. In other words, is the product suitable for its intended use? One company expressed it this way: DOD is devoted to specification requirements; commercial customers are devoted to results.

Customers have no unilateral right to direct changes in commercial contracts. This means that changes must be negotiated technically, and priced, before they are made. This allows the vendor more stability in his planning and manufacturing, and thus contributes to the ability of vendors to establish firm prices for work that the Government would buy using an incentive arrangement. One U.S. firm told the team they would accept more FFP Government contracts if the "Changes" article were omitted.

Commercial pricing is done more on the basis of market value and competition than cost plus profit. A vendor can include whatever contingencies he feels the traffic will bear, knowing that he can price himself out of the market if the competition provides an equal quality product at a lower price or a better quality product for the same price. The low bidder is not always the winner in the commercial world. Almost all the firms interviewed were willing to pay a higher price to deal with a vendor they were confident would satisfy their requirements, provided they were not gouged. Customer demands for quality are increasing, and industry has perceived that customers will pay more for a quality product.

Past performance ranked high in their criteria for selection of a source. In fact, it is the dominant factor in many cases. A major aircraft manufacturer repeatedly told the team that the only way to achieve quality is to find a way to exclude the marginal performer from future business. Vendor rating systems are a vital part of the overall business strategy of the firms visited. The systems in use by the companies vary in sophistication with the

complexity of equipment and amount of subcontracting involved, but they all serve to exclude the unacceptable vendor, and flag the questionable one so that suitable controls can be imposed. By regulation, the Government must buy from the low bidder unless he can be shown to be non responsive or his technical approach does not fully satisfy the contractual requirement. The burden of proof, in a protest, is on the Government. Experience has shown that it is difficult to sustain a determination of non-responsibility or technical superiority. The low bidder rule is often cited as the reason the Government must stay fully engaged with its contractors. When cost analysis is used in commercial buying, the negotiators are often industrial engineers, or other technical experts knowledgeable about the product, rather than the accountants or financial experts the Government generally uses.

The general perception by a commercial firm is that the market is elastic to quality performance as well as price. They can make a determination of what the market will be and accomplish long range planning accordingly. They maintain they cannot make such determinations regarding the Government market. Government rules about competition and component breakout, along with the annual appropriations process, are cited as the primary reasons.

The teamwork aspect of the commercial company and its suppliers provides an interesting comparison with the relationship between the Government and its suppliers. Before award, the commercial firm is much tougher than the Government would be; using negotiation tools prohibited by our procedures, such as auction techniques. Once a vendor is selected, the relationship becomes a cooperative one, in pursuit of a common goal. The Government negotiating team, on the other hand, has generally cooperative arrangements before award, becoming adversarial after. In most cases, problems exasperate this adversary relationship, so that when the parties most need to be pulling together, they are likely to be engaged in a tug-of-war, where the solution to the problem takes a back seat to placement of the blame. Commercial firms tend to work a problem with industrial engineers and quality specialists, where the Government would use lawyers and accountants. Stable technology (commercial) vs advanced State-of-the-Art technology (Government) is a contributing factor to this situation.

Commercial warranties in the United States, Japan, and Europe tend to be relatively straight-forward and non-complex, applying to materials and workmanship only (not design or processes) for a specified period of operating time or calendar time. Warranty terms are usually established by competition, and firms try to get warranties from vendors consistent with the warranty they offer the consumer. In a number of cases, though, warranty costs are not charged back to the vendor unless they reach some previously established threshold of financial pain for the company. In several instances, this threshold was 3% of cost of sales. In some cases, the warranty is not even specified in the purchase order, but simply an understanding on the part of the vendor as to what level of quality is expected. Clearly in the commercial world both within and outside the United States, it is not the contract guarantee that drives quality, it is company policy and the promise of future business.

Firms that do a high volume of business in a product line generally have historical data to price warranties, but this becomes almost irrelevant at times, because the competition sets the terms of the guarantee. Often, firms decide to assume responsibility for correction of a defect on the basis of the cost of the correction and the predicted loss of customers if they do not make good, even though they have no legal obligation to do so.

The Quality Horizons team also observed a wide variety of contracting techniques, including warranty approaches, in the AFSC Product Divisions and the other Government agencies visited, both U.S. and foreign. All agencies used some firm fixed price and some form of cost reimbursement contracting. Cost-plus-a-percentage-of-cost (prohibited by law in U.S.) is still used to some extent in Germany, while Japan uses cost-reimbursement contracts with a ceiling arrangement which the supplier exceeds at his own risk. Fixed price was the preferred form in all locations. In Europe and Japan, one year warranties are used, covering materials and workmanship. In the U.S., DOD contracts range from CPFF to FFP, with a wide variety of incentive and warranty arrangements.

One incentive technique employed by DOD that is widely accepted as effective is Award Fee. This provision is generally used where there is inadequate information to prepare detailed specifications, where emphasis is subject to change during the life of a contract, or

where an item of special importance to the Government is of only peripheral importance to the contractor. Award Fees are useful where warranties would not be, and they keep the communication channels open between the seller and the customer. At both NASA, Houston, and a DOD contractor in California, an Award Fee allocation to Quality Assurance increased the stature of the QA organization by assuring visibility and emphasis by program and company management to the quality requirements. Thus, their participation was solicited commencing in the early design phase. Both Government and contractor program managers recognized a new emphasis on quality. The Quality Assurance manager of the California firm stated that with several hundred thousand dollars riding on quality he became an important part of the program management team.

The Navy's lease satellite program is the closest emulation of the commercial environment by a Government buying activity encountered. This satellite is to provide secure communications with ground stations for five years. All financing of this program is done by the contractor, with payments beginning when services begin, in orbit, in October 1981. A performance specification is used, and commercial time sharing is permitted. While the Navy will exercise close technical surveillance, design control remains with the contractor.

In all the AFSC Product Divisions, there is increasing emphasis on the use of warranty provisions; such as Reliability Improvement Warranties (RIW), Correction of Deficiencies (COD), and some limited use of standard commercial warranties. Unfortunately, use of a RIW or other guarantee has not generally resulted in reduced in-plant surveillance, or changes in contract quality management system requirements. Thus, the Government may be conducting needless contractor monitoring and paying additional costs. Whether the increasing use of these provisions has improved quality or whether they are cost effective is hard to judge at this point. It is generally agreed that RIW provisions are serving to improve the feedback of information to the manufacturer to assist in the correction process. Whether an effective warranty can be negotiated depends in large measure on the competitive nature of the purchase. The Government is generally able to include warranties in competitive contracts. In sole source situations, the contractor tries to establish a price that is prohibitive, or so emasculate the provision as to render it worthless.

In summary, there are more than enough tools available to the contract negotiator, but none of them are foolproof. There is no substitute for intelligent assessment of the government's objectives and selection of a business strategy consistent therewith. Ideally, the best contract would be referred to the least and the best warranty would never be referred to at all. Specific strategies for an acquisition should be tailored to the program and the contractor, keeping in mind that no form of assurance is free, and that the objective should be to get the most for the taxpayers' money.

F. Motivation

One could postulate a "hierarchy of needs" for the American worker, and at its base would be job continuation. A majority of the United States firms visited rely primarily on the promise of future work to motivate their work force. Many companies in the United States have such high worker turnover, or such heterogeneity in the work force, or both, that training programs or other motivational programs have been futile. Thus, job continuation as a motivator is augmented only by negative motivation (discipline).

Where the labor force is more stable, there are some motivation programs in operation in the United States. QC Circles, upward mobility programs, and other, generally ad hoc, programs are used to encourage quality and productivity. Employee recognition programs tend to be noncompetitive; that is, everyone can win, and they offer nominal rewards like coffee cups or T-shirts. The programs are considered effective, but need constant rejuvenation. The study team heard mixed reactions to QC Circles in the United States; some firms are using this approach with some success, others without any success, and still others say the notion is only a gimmick and will not work in this country because of the cultural differences and the heterogeneous work force.

One large firm told the team that their system of promotion sorted out the self-motivated people so well that there was no need for any other program of job enrichment. Other firms told the team that the professional workers, e.g., engineers were self-motivated, and that management emphasis improved quality more than any other factor. The design engineer will resolve cost and quality problems if they are presented as requirements equal to other performance considerations. Top management attitude is the key to improvement in this area.

In Japan, Zero Defects Programs are still effective. However, the main motivator is QC Circles, which originated in Japan about the same time that Zero Defects got its origin in the United States. Zero Defects and QC Circles both emphasize elimination of defects. Zero Defects, however, centers on the individual while QC Circles center on groups of workers. QC Circles are a form of participatory management in which workers, usually 6 - 10, form a group which periodically meets to review their responsibilities, problems encountered and to suggest ways to improve work performance. The suggestions may cover any area which will improve productivity, quality or the work environment. One company reported savings of approximately $250 million every 6 months as a result of this suggestion program. High worker morale is achieved because the workers accept their responsibility for product quality and are proud of their achievements. The Japanese workers are further motivated by a bonus system. The workers may earn bonuses of 40% to 60% of their salary depending upon their individual and group performance and the company profits. High levels of training, low turnover rates and the paternalistic attitude of management also contribute to high worker morale.

In Europe, the team observed the beginning of QC Circles, but the primary motivator seemed to be upward mobility programs based on employee performance. They also have recognition programs using certificates and awards. Representatives of several European firms talked about the de-motivating aspects of overly detailed procedures and also of the difficulty in getting the worker to take responsibility for his work when an inspector is looking over his shoulder each step of the way. Bonus payments in Europe, like in Japan, are common. Traditional craftsmanship is also a factor in Europe with the satisfaction of having done a good job the primary motivator.

The issue of motivation is a difficult one. Programs of all types seem to work, for a while, but experience would indicate that they are difficult to sustain. The programs that have endured are "tradition" in Europe and QC Circles in Japan, but they still require sustained management emphasis. Where management was slow to respond to worker needs, failed to adequately consider worker comments or failed to continue support of the motivation programs, the programs

ultimately failed. While no panacea was observed, it was generally found that large organizations need simple and sincere motivation programs to foster pride in workmanship and a sense of belonging. While these programs are not universally successful, within each company some form of motivation did seem to contribute to employee concern for the company's image as manufacturer of quality products.

G. Field Services

The field service support provided by industrial firms is dependent on the customer (consumer, industry or government), the complexity of the product, and the warranty provided. Products sold to consumers are generally serviced by sales and service centers or returned to the factory. The primary concerns of the producer are to minimize warranty expenditures, to maintain user satisfaction and to remain competitive. With products sold or leased to other industrial firms, the producing firm normally does not get paid until the unit is proven acceptable to the buyer. These products are generally more complex than consumer products. Field service costs for commercial items are included in the purchase price while field services for military systems are separately priced. Field services are generally not used on military systems unless no other alternative appears to exist for a specific problem such as untrained personnel.

Field service in the companies visited was located in various organizations. These included engineering, manufacturing, quality and marketing. In some firms, the field service organizations were separate profit centers if they provided field services for all corporate products.

Some of the basic functions performed by field service organizations are technical assistance, analysis of field complaints, training, and accurate and timely feedback of failure data. The field service representative may perform or advise the user in performing maintenance on the system. In addition, since the field service representative generally has a direct line of communication to the manufacturer, the response time necessary to provide technical assistance for resolution of maintenance problems or customer complaints is greatly reduced. A field service representative may also provide technical assistance through a purely advisory role.

Accurate and timely data feedback and analysis of field complaints provide the manufacturer with the information necessary to improve customer satisfaction and determine trends in performance and/or reliability. A universal complaint that the study team heard was that data available to the contractor on system performance of military systems is not timely, accurate or complete. In most non-military situations the primary measure of quality is the cumulative in-service reliability of all field units of a particular product. Complaint analysis and data feedback provides the manufacturer with the data necessary to mature the system.

The policies for providing field services are varied and dependent on several factors. Of prime concern is the customer's requirements. Field service provided to the consumer is generally limited to the sales and service centers which provide warranty as well as post warranty maintenance or replacement. If the customer is another industrial firm, field services provided are dependent on the warranty specified by the terms and conditions of the contract and the pressures of competition. In some European countries, field service is often not a distinct entity because the national laws require all products to be warranted. Therefore, the law levies on the producer the repair responsibility. However, some firms have extensive field service organizations because they do not receive final payment until their product is installed and operating as specified. It was noted that the military, in the countries visited, separately contracted for maintenance and field support except for products that were covered by warranties. Where items were covered by warranties, the product was returned to the factory for repair. In Germany, if the item was commercial or a commercial derivative, the item could be taken to the commercial sales and service outlet for repair. Where field service was required in Germany, it was separately priced but often provided at cost.

The warranty duration was also a driving factor in companies' decisions to provide field services. In product lines which had long service lives such as telephone systems purchased by European companies, there were extended warranties. In the United States, the manufacturers of telephone equipment assign representatives to the operating companies who in turn lease the equipment to the customers. Whether purchased or leased, equipment must meet specified reliability requirements; otherwise,

excess maintenance costs are passed back to the manufacturer. Field service personnel are invaluable in identifying and helping resolve problems and minimizing total systems costs.

The commercial portion of the aerospace industry in the United States provides field service support for a specified period of time after delivery of the last aircraft of a certain model or as long as there are a certain number of that aircraft in service. Several factors favor the use of field service personnel on the commercial side of the aerospace industry. The first is competition. Even though an airline may have a considerable investment in one manufacturer's equipment, they have the option of purchasing similar equipment from another manufacturer. Aerospace companies must provide service to insure a high degree of customer satisfaction. The second factor is that the aerospace companies have design flexibility and responsibility. The aerospace firms can, and must by FAA direction, make design changes if a safety problem is discovered. To a large extent they can also change the design to increase product reliability or performance or decrease manufacturing costs without prior customer approval. When changes other than those directed by the FAA are made, the airlines have the option of incorporating the changes in the aircraft already in service and are generally provided modification kits at a low cost. Field service representatives provide much of the data necessary to make design changes. A third factor is the method of contracting. Commercial contracts are relatively short and specify the what-when-where and how the customer is purchasing. This includes delivery dates, warranties, performance and special equipment that the customer wants. All services which will be provided both before and after delivery are included in a single price. Usually when the airline performs maintenance covered by warranties, the producing firm is charged for all or part of the expense involved. Field services in this case verify that the work was in fact warranty work. The final factor is technical support during early organic maintenance. The airlines, much like the Air Force, start providing maintenance as soon as the system is in operation. Field service representatives assist in the maintenance of the aircraft and training of personnel.

H. Government Involvement/Surveillance

The study team evaluated the FAA involvement in the commercial aircraft industry. In this area the FAA is regulatory in nature since the Government (FAA) is neither the buyer nor the user of the equipment. The FAA certifies the aircraft (airworthiness) and the manufacturer's production plan, methods and techniques (Production). The Airworthiness Certificate is basically awarded as the result of design analysis and testing in accordance with the applicable Federal Air Regulations (FARs). The Production Certificate is based on the actual manufacturing of the article.

The FAA makes extensive use of Designated Manufacturer Inspection Representatives (DMIRs) to perform surveillance of the manufacturing processes. They are company employees who are intimately knowledgeable of the manufacturer's processes and procedures as well as the FAR requirements. DMIRs are selected by the company and approved by the FAA's Principle Inspector for the facility. They actually wear an FAA hat while on the company's payroll in assuring that the company procedures, inspections, etc., are in accordance with the FAA requirements and are adequately performed. The FAA's Principle Inspector for the facility monitors the performance of the company's DMIRs. Those FAA and company representatives interviewed felt that DMIRs have no conflict of interest. They indicated that DMIRs would not hesitate to reject a nonconformance regardless of the impact it might have on the company's delivery schedule or cost. The reason given was that DMIRs consider their positions very prestigious and thus are self-motivated to maintain their status. They do not receive extra pay for this position; however, they are usually senior employees and the position provides additional job security.

The FAA assigns a Principle Inspector and occasionally additional representatives to a manufacturing facility. The FAA Principle Inspector is responsible for conducting surveillance to assure that the manufacturer remains in compliance with FAA requirements. Primary functions include:

1. Approval/evaluation of QC data.

2. Evaluation of inspection/quality assurance of manufacturing and special processes.

3. Conducting compliance/conformity inspections of products.

4. Training, supervising and monitoring the DMIR activities.

5. Investigation of in-service difficulties.

6. Investigation of regulatory violations.

7. Assurance that effective corrective action is taken for all unsatisfactory conditions.

Periodically, the FAA (regulatory) conducts a Quality Assurance System Analysis Review (QASAR). A team of highly trained FAA personnel conduct an in-depth review of the manufacturer's conformance to the FAA approved plans and procedures upon which the Production Certificate was granted. The contractor's incentive to maintain compliance with the approved plans and procedures is the threat of losing the Production Certificate which is essential to certify the aircraft as airworthy. An additional impetus that encourages contractors to comply with FAA regulations is the threat of civil penalties such as large fines or imprisonment and the notoriety such actions receive through the media.

The FAA in the role of customer (FAA uses the equipment) performs much like that of a program office during system acquisition. The FAA first reviews the contractor's manufacturing and quality programs for acceptability. If acceptable, the contractor's Quality Plan is certified; then, any changes desired by the contractor must be submitted to the FAA for approval. Subsequent to Quality Plan approval, the FAA maintains minimal representation within the plant. Many FAA contracts require the installation and checkout of the system before payment. This provides additional assurance that the system will function satisfactorily before relieving the contractor of his responsibility.

The U.S. Army (DARCOM) involves the quality assurance organization in each phase of an acquisition life cycle: conceptual, validation, full-scale development, production and deployment. The Army designs much of the equipment they purchase. Most of their equipment is manufactured by contractors under the cognizance of DCAS. Extensive use is made of the Letter of Instruction (LOI) by the Army. Through the LOI the procuring offices can direct the activities of the in-plant

government agency. The Joint Service Regulation for Procurement Quality Assurance Programs (DLAM 8200.1) is used at those contractor locations under cognizance of the Army as well as those under DCAS.

DCAS has used the concept contained in DLAM 8200.1 since it was published in 1962 and recently developed the Contractor Assessment Program (CAP) as Appendix D of DLAM 8200.1. This program is currently being tested at carefully selected locations. The agreement signed by the contractor (DLAM 8200.1, Appendix D, Fig 6) contains the following elements that are not required by MIL-Q-9858A: (1) obtain government concurrence prior to changing identified key elements of the company's quality control program; (2) audit product inspection after normal company inspection is complete; (3) evaluate the company's quality procedures through periodic compliance reviews; and (4) report the results of monitoring and reviewing actions to the government.

CAP requires the contractor to accomplish most of the activities that were previously accomplished by the government QAR. This permits the contractor's workforce to maintain a more consistent and efficient flow of work, since they do not have to wait for DCAS inspections (except for established mandatories) before moving parts or materials from one work station to the next. More of the DCAS QAR's effort is spent on assuring that the contractor's quality assurance system is properly controlling the manufacturing processes, that the contractor's system is detecting nonconformances preventing them from being built into products or going into inventory and assuring that corrective action is taken to prevent recurrences. This is accomplished by a more flexible inspection schedule with a more disciplined reliance upon statistical sampling and lot acceptance techniques. This not only permits the QARs to evaluate more areas of a contractor's operations, but it also allows them to concentrate their efforts in areas where problems have been detected. Once these problems are resolved, they then concentrate on other areas where sampling inspections, reviews of contractor's records or other monitoring have indicated potential problems.

Those contractor and DCAS representatives interviewed felt that the CAP system resulted in a much more effective and efficient utilization of scarce government resources. In most cases moderate reductions in the number of in-plant government inspectors were achieved. It also improved the working relationship

between the DCAS and contractor in that the emphasis was on the contractor's system and data, not on trivial concerns which often create animosity. The contractor is truly considered responsible for the quality of his product. Contractors maintain that their management is motivated to make sure the program works because they are proud their company was selected for CAP. They also indicated that their employees are motivated to do a better job. While data is not yet available to conclusively evaluate the CAP impact on product quality, contractors maintain that it has not degraded product quality and in some cases has enhanced it. The DCAS organizations visited support continuation of the program as a valid tool to place more quality responsibility on contractors without abnormally increasing government quality risks or reducing confidence levels. The very limited CAP data shown to the study team did not reflect any product quality degradation due to withdrawal of in-plant government inspectors.

The Navy Plant Representative Offices (NAVPROs) previously conducted the in-plant quality assurance program specified in DLAM 8200.1. Currently, the NAVPROs are implementing a separate Quality Assessment Program (NAVPRO QA Procedure 4.3.4). This program establishes product verification teams responsible for discrete manufacturing areas. Their verification effort is accomplished less frequently than required by DLAM 8200.1, but in more depth. The results of each verification are formally presented to the contractor's top management for action. This program differs from the DCAS CAP in that the NAVPRO does more verification of product conformance through actual inspections.

Government involvement at contractor plants under Air Force cognizance does not vary greatly from that of other government CAS organizations. AFCMD has developed and implemented the Contractor Management System Evaluation Program (CMSEP) which is designed to accomplish evaluations using the management systems approach. The baseline for this program is the contractor top management official's assignment of responsibilities to his functional directors. Verification of contractor compliance to contract requirements is assigned to the various AFPRO functional divisions according to this baseline. Each contractual requirement is checked by specific condition questions (management system indicators) which the AFPRO personnel use to determine the

existence and adequacy of the contractor's written instructions. Subsequently, the AFPRO personnel verify that the contractor's employees are complying with the written instructions through procedures verification monitoring and product inspection verification. The quality assurance function uses this approach for verification of both management procedures and work instruction procedures. The verification of compliance to work instructions is a continuous evaluation while the verification of compliance to management procedures is a scheduled activity.

In Japan and Europe, government involvement for defense work is very similar to that in the United States. Other sections of this report provide data concerning their efforts and manpower allocations. Generally, it was observed that in Japan and Europe the work force of government quality assurance was one representative to ten contractor quality representatives; within AFCMD the ratio is closer to one government QAR to 20 contractor quality representatives.

I. Summary

Many managers engaged in the military acquisition process on both the government and contractor sides give lip service to quality and the "ilities". Managers generally recognize the importance of these efforts and want front end attention to defect prevention, reliability and maintainability, but only to the extent that noncompeting funds are available to support their related costs. Detracting from the level of importance given to the "ilities" is a general lack of appreciation on management's part as to the trade-off analyses that are possible in these specialities. Thus, the manager often feels confronted with "all or nothing" choices as to "ility" requirements. Often neither of these choices would have resulted from a trade-off study which included the costs of product failures caused by the omission of these requirements. To establish tailored "ility" requirements that are consistent with cost, schedule and performance constraints requires sufficient manning and skill levels. Unfortunately, these levels are generally not available. Thus, the program manager may have inadequate information upon which to decide the apportionment of limited funds for competing requirements. Another factor contributing to the early de-emphasis of the "ilities" is that the pay-off from these programs is often not realized by the manager having this decision

responsibility. The impacts of not performing these tasks are realized much later by the manager's successor or by the operational and support organizations.

In addition, many military and DOD contractor acquisition managers do not take the time and effort to fully understand the tools, techniques and benefits of the assurance engineering disciplines and some of the managers are also reluctant to properly man, fund or accept the recommendations of these specialists. Rational management decisions predicated on objective evidence of cost payoffs is emphasized. However, it is often easier to measure the costs of failure, than to cost success in these disciplines. Managers must recognize that unless properly manned and funded, these functions cannot effectively or efficiently support the acquisition objectives nor can adequate information be provided so that well informed management decisions can be made.

V. NEW APPROACHES TO AFSC PRODUCT ASSURANCE

A. Introduction

The Quality Horizons Study Team's recommendations presented in this Section are summarized in an Action Plan. The Action Plan contained in Appendix I has been prepared and organized to facilitate review, implementation and tracking of approved recommendations. The Action Plan contains a cross reference to this section of the report for additional information as may be required.

This section is grouped into the following eight categories in order to provide for a logical and sequential development of the new approach to product assurance:

Policy

Organization

Manning

Education/Training

Contract/Subcontract/Warranty Arrangement

Motivation

Government Involvement/Surveillance

Life Cycle Product Assurance

The study team has observed that there is a common thread that permeates all successful programs, both commercial and military. That theme is that there must be a disciplined approach to planning, utilizing the assurance disciplines. Design guidelines must be developed that are consistent with cost, schedule and performance requirements. Then throughout design, development, and production phases; analyses, controls, and conformance verification must be implemented to assure that the product will perform as required in the intended environment. Quality considerations must be an inherent part of the product design, development and test.

Programs that have been most successful have utilized these concepts extensively with significant emphasis on the front end design efforts that will eliminate or minimize product assurance risks. In each case these efforts began with and were continually demanded by top management. Management established specific program requirements and then assured that integrated trade-off analyses were conducted in each area to develop a program plan that would accomplish these objectives within cost and schedule constraints. Program management considered not only the inputs of each program element but assured that each element's input represented a coordinated and integrated position. Program decisions were based on complete information. The recommendations that follow are designed to achieve these same results within AFSC and meet the Quality Horizon Study objectives set forth in Volume II, Section 4.

In order to fully recognize the scope of the concept presented in this section, it is imperative that the definition of PRODUCT ASSURANCE be understood. The application of these concepts to the traditional view of quality as only a conformance discipline will result in misunderstandings. A new phrase rather than redefinition of an existing term, was specifically selected to call attention to the fact that a new approach is being recommended for use in AFSC.

> *PRODUCT ASSURANCE is the application of interdisciplinary skills to accomplish the preventive and conformance activities necessary to assure: that requirements are properly specified, that the design will achieve these requirements and that the ultimate product and/or services will perform their intended functions in the operational environment for the period specified.*

Many skills, disciplines and sciences contribute to or have responsibility for product assurance, not just the quality function. Quality, reliability, maintainability, etc., must be designed and manufactured into the product not just measured through inspection or tested in, although both inspection and test are essential for verifying conformance. The product assurance concept can, given the opportunity, integrate these complimentary actions currently fragmented within AFSC.

B. Policy

The objective of AFSC's research, development and acquisition programs is to provide the using commands with products and services that fully satisfy mission requirements and user expectations. To achieve this objective, a combined effort is necessary to assure that proper technical requirements are contractually specified and that the products conform to these specified requirements.

Top management attention by AFSC and industry is essential to attain this goal. General Slay's efforts, including the direction of this study effort are well known to AFSC and industry. His direction to implement recommendations of this study will further support management's resolve to assure better quality products to users. Such management actions will be essential in order to shift AFSC's emphasis from problem detection and correction to one of prevention as described under the product assurance concept.

Although government/industry teamwork and excellent management have resulted in some nighly successful programs, these effective management initiatives must be institutionalized and used on a broader basis. Current guidance in DOD Directives, AF and AFSC Regulations in the individual functional disciplines (e.g. MIL-Q-9858A, MIL-STD-1543, AFSC 74-1, etc.) is generally adequate. However, since the implementation of this guidance is often incomplete or not effective, AFSC's and industry's top management must assure that the proper emphasis is given to product assurance. To attain this objective an AFSC Regulation that integrates the tasks and functions defined in the current regulations, standards, etc. must be developed. This Product Assurance Regulation will not only provide for more effective use of scarce resources by preventing duplication of efforts, but its orchestrated approach will assure a program orientation that minimizes program risks and achieves the required performance at the lowest possible cost. It will incorporate a system of checks and balances to assure that each organizational level fulfills assigned responsibilities. One such verification requirement would be to justify to program management the inclusion (or elimination) of each specific product assurance task or function required by this regulation. Such management emphasis will elevate these performance requirements to a level of concern equal to cost, schedule and other performance considerations.

Many managers do not recognize that the assurance disciplines have evolved from "black arts" to engineering sciences with proven tools and techniques for their proper application. These functions are no longer fragmented efforts but complement one another. Their analyses, applications and evaluations rely upon the same basic data, such as, failure mode analyses. Yet, many responsible and competent individuals within these functional disciplines have not been exposed to the experiences of other programs or the tools and techniques effectively or ineffectively used by them. Effective lessons-learned and training programs must be undertaken to provide AFSC personnel with the opportunity to perform to their fullest capabilities.

Expertise and experience acquired on one program must be transferred to all AFSC organizations. One valuable method of achieving this objective is through a formalized lessons-learned program which will reinforce AFSC's corporate memory. The method recommended to accomplish this would be to develop AFSC Handbooks for each functional discipline. Each handbook would contain guidelines for applying the tools and techniques of the specific discipline and how it interacts with other assurance disciplines. The guidelines should include a brief description of the tool or technique, how it is applied for various products and contracting methods, the benefits it provides, approximate costs associated with its specific applications and the risks of not performing these tasks. An OPR for each discipline must be established who will be the focal point for lessons-learned by all organizations. The OPR will be responsible for assuring the incorporation and distribution of all changes. Several pamphlets, handbooks, product division standards and office instructions have been developed with much of this information. However, these documents have not been distributed to other AFSC organizations nor do they always incorporate lessons-learned from other organizations.

To maintain management emphasis on product assurance, the visibility and knowledge of this element of a program's performance must be of prime concern. To do this, AFSCR 800-23 should be revised to require each Program Manager and Air Force Plant Representative or CAO Chief (DCAS/NAVPRO) to report on product assurance successes and problems at each Command Assessment Review and Program Assessment Review. Additionally, program managers should stress to their contractors the

importance of including product assurance status, problems and concerns in program technical and management reviews. Reporting of product assurance requirements is already accomplished in many forms such as data item description submittals and functional management reviews, but program management frequently does not receive even a summary of these reports. Contractors and project officers should be required to brief program management on these items.

The suggested new approach to AFSC product assurance is necessary to provide the methodology and assure the consistent and disciplined application of these policies by management.

C. Organization

The recent trend in DOD, as well as industry has been to combine some, or most of the assurance disciplines into one organization, reporting to top management. The Army (DARCOM) was the first service to do this, followed by the Navy (NAVMAT), and the Air Force (AFLC). There is no quantitative data to prove that these organizational changes have resulted in improved product quality. It would be difficult to accumulate such data for any organizational change, but increased attention to the assurance disciplines was observed in the combined organizations. The Quality Horizons' Study Team believes that a similar organization change in AFSC would be required to maintain and improve quality levels during the current trend of diminishing resources.

The recommended organizational change will eliminate the current fragmentation which exists in the assurance disciplines by combining the primary functions which impact the quality, reliability, safety, etc., of the product. This will facilitate communications between Hq AFSC and all subordinate levels. In addition, this organization will promote consistent application of the tools and techniques available to the product assurance disciplines, optimize implementation of lessons learned and use of manpower resources. Even more significant is the fact that the proposed organization will raise the level of influence that the assurance disciplines have on program decisions in all phases.

The critical mass of personnel and centralized focal point for product assurance attained by this new organization will enhance their overall program orientation. The currently fragmented structure forces a myopic

view ("cultist" orientation) that often does not consider the overall program objectives or constraints. The integrated positions developed through this new organization will permit more informed program management decisions resulting in delivery of a quality product that meets user needs at the lowest possible cost.

The organization in AFSC which will be most successful in improving product quality is one which combines the assurance functions specified below. This organization should be titled Product Assurance and report to the Commander at Hq AFSC and subordinate units. While it is true that the individuals assigned to an organization have a strong influence on its success or failure, the proper organization structure will enhance the probability of mission success.

The new product assurance organization will be responsible for the following functional disciplines which are currently being accomplished by various organizations in AFSC:

1. Quality Assurance
2. Reliability
3. Maintainability
4. System Design Safety
5. Manufacturing (except at AFCMD)
6. Standardization
7. Corrosion Control

Included in each of the above areas would be all of the tools, techniques and subfunctions which support these areas such as: Man-Tech Program, Q-Tech Program, nondestructive evaluation program, quality assurance engineering, product assurance testing, metrology, software quality assurance, vendor quality assurance and producibility, derating, failure mode analysis, parts control, etc.

The main advantages to the product assurance organization are:

1. It enhances front end involvement during design and development phases.

2. It combines similar functions which are interrelated and are currently fragmented in different organizations in AFSC.

3. It provides clear and direct lines of communication by establishing organizational symmetry.

4. It reduces duplication of efforts, multiple interpretations, and conflicting direction from different activities.

5. It increases productivity and manning flexibility by combining personnel with related disciplines and overlapping capabilities. It provides for a critical mass of personnel at those organizations where manning is not adequate to support an office in each of the disciplines.

6. It overcomes the tendency for different functional disciplines to compete on an individual basis for funding and manning resources and develops a broader perspective toward total program needs.

7. It provides for continuing visibility and attention to product assurance by top management by requiring that the organization report directly to the Commander.

8. It gives product assurance an independent and stronger voice in management and program decisions so that product assurance will not be subordinated to cost, schedule or other performance requirements.

9. It improves career progression and the ability to attract and maintain highly competent people.

10. It demonstrates to contractors that AFSC thinks product assurance is as important as other performance parameters.

The primary disadvantage is that it will increase the span of control for the Commander, Hq AFSC and Product Division Commanders. On the other hand, the span of control at AFCMD will be reduced and it has the potential for reduction in program offices.

Figure 9 shows the proposed organization with its direct line of communication.

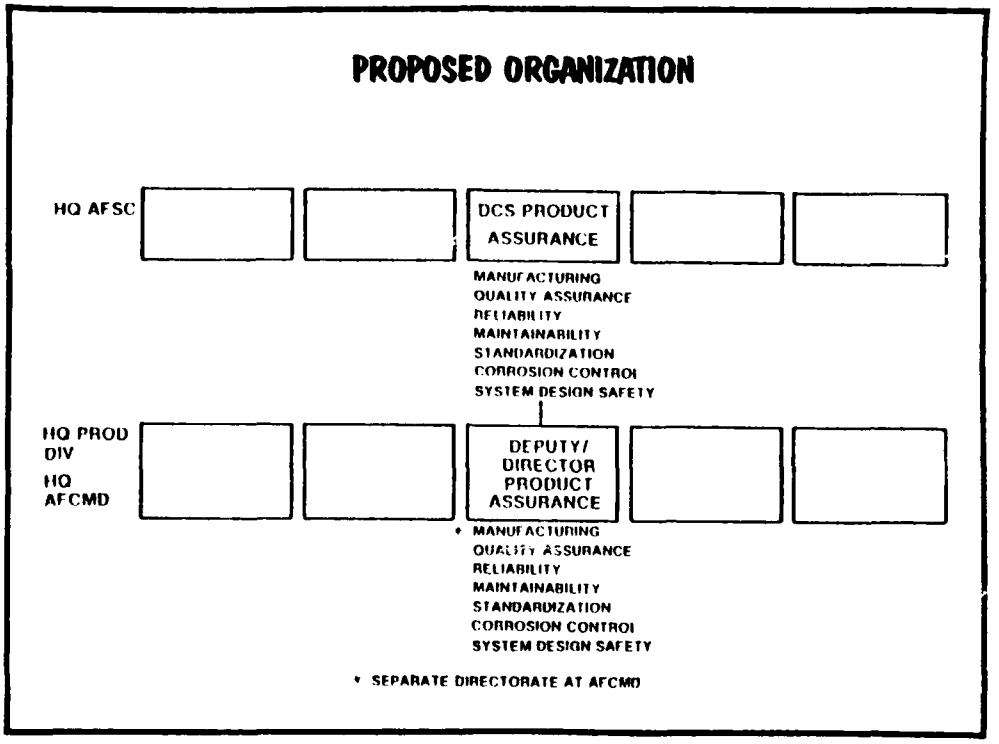

FIGURE 9

If the above organization is not considered practical at this time, an alternative would be to reorganize in two phases. Phase one should be to reorganize and combine product assurance disciplines at HQ AFSC only. This would emphasize to AFSC field organizations the need to enhance product quality through a teamwork approach of product assurance and assure greater attention to these disciplines early in the design and development efforts. Over a period of time, an evaluation should be accomplished by HQ AFSC to determine if the early involvement product assurance concept is being effectively accomplished at the field organizations. If not, phase two should be implemented, i.e., the reorganization and combining of product assurance disciplines at all AFSC field organizations. This would institutionalize the product assurance concept and enhance its accomplishment at the Product Divisions and AFCMD.

Action should also be taken to transfer the expertise and program knowledge derived from the initial acquisition activities by the product divisions and

program offices to the contract administration offices at the contractor's plants. An effective way to accomplish this transfer of corporate knowledge is through strong communication channels between the product divisions, program offices and contract administration offices. Since a large number of AFSC contracts are administered by CAO's outside AFSC (DCASs and NAVPROs), communication with these organizations must also be strengthened. The number of AFSC contracts under DCAS administration warrants the establishment of a DLA liasion office at each Product Division to facilitate communications. This will enhance the ability of program offices to relate concerns and problems and attain confidence in the contractor's performance as reported by the CAOs. This will permit DLA to re-allocate their resources accordingly and will strengthen the working relationships between these team members, enhancing overall effectiveness.

D. Manning

It was generally observed, in those organizations where assurance disciplines were combined, that the quality assurance manning was distributed more heavily toward the front end of the product life cycle than is the case currently in AFSC. Thus, without changing the basic assumption that no additional manpower resources will be requested, (except for the possibility of an intern program which is described in V.E.), re-allocation of existing manpower is recommended. All of the manpower currently performing the assurance missions listed under Section V.C. - Organization, would form the pool for this ultimate re-allocation.

Under the product assurance concept, there will be a much greater involvement by product assurance personnel in the earlier phases of the acquisition cycle. This early emphasis on prevention will provide a greater return on existing manpower resources and investment thus allowing for the re-allocation of critical manpower within the product assurance community. The objective should be to assign current resources to those product assurance organizations where they can provide maximum benefits. Currently, there are 56 full time quality assurance personnel in AFSC program offices and product division staffs and 1,184 quality assurance personnel in AFCMD. Thus, approximately 5% of the AFSC quality assurance work force is located in the four AFSC Product Divisions.

The first step necessary to man the new organization should be to identify those resources currently performing the product assurance functions in Hq AFSC, AFCMD, ADTC, ASD, ESD and SAMSO and transfer these resources to the product assurance organization in each of these activities.

It may eventually be necessary to strengthen the manning levels and ability for AFSC personnel to become more involved in early design and development efforts. This should be done by the re-allocation of personnel and vacant positions to the systems program offices and AFCMD activities that can best influence design and development. While an increase in product assurance manning within the Product Divisions is anticipated, an independent study team under Hq AFSC leadership should be formed to determine the most effective allocation of product assurance resources and skill levels within AFSC. The team composition should include representatives from Hq AFSC, Product Divisions and AFCMD, and work in concert with General Slay's direction for a Workload/Manpower Baselining Study (4 Apr 1979). When the study is completed, a plan should be developed to accomplish the re-allocation.

There should be no reductions-in-force or other adverse personnel actions. The initial transfer of personnel from the AFCMD to the Product Divisions would be on a volunteer and selection basis. Subsequent transfer of spaces would occur as spaces become vacant through attrition. Not all vacated spaces should be transferred, but this should be done on a planned schedule until the predetermined re-allocation is complete.

In addition to the realignment of product assurance resources, there should be a concurrent upgrading in the professionalism of the entire work force. Emphasis should be placed on college graduates in the assurance sciences with the prerequisite individual capabilities. Goals should be established within AFPROs to increase the number of appropriate college graduates in product assurance using as a guideline the percent of college graduates in the comparable contractor's work force. Needs of the organization and ability to recruit college graduates should be considered in establishing this goal.

When specific skills are not available within AFSC, a decision must be made to retrain existing resources or contract out for these specialized

skills. AFSC should establish a Command Policy to support contracting-out where necessary.

E. Education/Training

The new AFSC product assurance approach will require significant emphasis on education and training to assure that the work force remains current in the techniques available to the product assurance disciplines. In comparing training available within AFSC to that available to the Army, Navy and DCAS, it was obvious that AFSC lags far behind. The Army, Navy and DCAS all have well established intern programs which concentrate on quality assurance and the related disciplines. AFSC has virtually no formal training programs and does not have a quality or product assurance intern program. U.S. industry does not normally have formal quality assurance training; rather, they concentrate on technical training. However, a good appreciation for quality and/or product assurance will be a natural outgrowth of a well developed technical training program. In Japan, there is extensive initial technical training followed by continuous training in quality assurance. In Europe, the emphasis is on technical training; however, special training in quality assurance is available and regularly used.

The percentage of college graduates in the AFSC quality assurance work force was one of the lowest observed in all locations visited. This lower level of education sometimes hampers the communication flow between AFSC quality assurance personnel and their industrial counterparts.

Over the past few years, the Japanese have raised their product quality level to one of the highest in the world. A major reason for this is the fact that managers, including top managers, receive a substantial amount of training in quality assurance.

The Japanese made us keenly aware of the fact that all levels of management must have a strong appreciation for the benefits to be gained from a product assurance program and they must continuously support the program if the full value of the benefits is to be derived. To achieve this goal, our top management courses such as the senior service schools, Defense Systems Management College, and the System Program Management course should be modified to devote an appropriate amount of time to the role of product assurance

rather than the token recognition currently given. The intent would be to instill in program directors and other top managers a sense of appreciation for the disciplines, when the approaches are best used, and the benefits from effective application of the assurance disciplines. In addition, current AFSC top managers and program directors must be made aware of the benefits they will receive from the new product assurance approach. This should be accomplished by a short, intensive, on-site program presented by an authority in the product assurance field. The investment in these training programs will be returned manyfold in improved product quality and reliability.

A concerted effort by AFSC must be made to raise the educational levels of quality assurance resources, especially in the AFPROs. This will bring the AFSC in-plant educational levels more in-line with their counterparts in the plants serviced by the AFPROs. Some adjustment in grade levels may be necessary to hire and retain the quality individual desired. However, the improvement in communications and problem solving ability would more than justify a slight increase in grade levels.

In line with raising top management appreciation for product assurance and the educational levels of the quality assurance personnel, AFSC must implement a formalized training program to upgrade the skills and capabilities of the product assurance workforce. The program must be centrally managed, adequately funded and supported by management. The resulting systematic approach will assure that AFSC personnel keep pace with industry in their areas of responsibility. The existing skill levels must be surveyed so that the need for development of specific courses for the AFSC-wide training program can be prioritized.

Developments resulting from the new AFSC Quality Technology Program (Q-TECH) may require new courses to be formulated and incorporated in the AFSC product assurance training program to keep the personnel up to date.

Another significant area which needs to be addressed is the establishment of a Product Assurance Intern Program. This program would provide a source of trained, capable and motivated people to fill the vacancies created by retirements or reassignments.

The intern program would produce graduates who understand product assurance from an AFSC perspective. They would be able to perform effectively in Hq AFSC or any of the AFSC divisions. The main theme of the program would be to develop individuals with the technical abilities necessary to perform effectively in journeyman level positions, yet who were also sensitized to program and business management. The graduates of the intern program would form the core of our future top product assurance managers.

The intern program should be centrally managed at Hq AFSC and supported by a distinct budget so as not to be diluted by other requirements. The training should be three years in duration consisting of formal classroom training, training at several AFSC organizations and some on-the-job training in contractor or AFPRO product assurance organizations. The number of interns should be based upon a percentage of the expected attrition rate for product assurance personnel. The program could support a minimum of 25 interns per year or approximately 75 interns when the program is in its third year of operation. It is reasonable to assume that approximately 25-50% of the vacancies occurring through normal attrition during any one year of the approximately 1950 product assurance personnel could be filled by the highly qualified graduate interns. It is necessary that AFSC provide 75 manpower authorizations to support this program. The use of overage positions would be acceptable.

AFSC should also explore the possibility of establishing an AFIT Education With Industry (EWI) Program for product assurance. This program should be made available to military and civilian personnel alike. EWI programs in other functional disciplines have proven to be beneficial.

Prior to developing the individual courses AFSC should evaluate the training courses and capabilities within DOD to determine what AFSC needs cannot be satisfied. If the capability does not exist within DOD, AFSC should develop or contract for the development of the courses. In those cases where there is a limited requirement for certain courses, AFSC should consider contracting with a private institution.

The education and training programs described above are the most pressing needs in upgrading the skills of AFSC personnel involved in product assurance. These programs will also provide the basis for a career development program for product assurance employees.

The Quality Assurance Office at Hq AFSC has begun this effort for quality assurance personnel. However, this effort must be continued and expanded to include the entire product assurance organization.

F. Contract/Subcontract/Warranty Arrangement

One of the major Quality Horizons' study objectives was to tailor and utilize commercial contracting practices to enhance product quality and support the established direction contained in AFSC/CC Policy Letter 22. Although this Policy Letter has been in effect for over one year, the Quality Horizons study team sought specific commercial practices that could further facilitate compliance with the existing policy.

An important step toward better hardware must be a better contract. Complexity and sophistication are not the ingredients that result in a quality contract. The most important ingredient is a clear set of performance specifications. The intended use of the desired equipment must be described in such a way that performance in the operational environment can be readily measured.

The statement of work should spell out clearly that performance will be measured during field use. The contractor has to know what it will take to obtain user satisfaction. The Statement of Work should then be subject to pre-Request for Proposal planning to include participation by potential proposers to assure a clear understanding of the requirement, the risks, and the responsibilities. Maximum use should be made of draft Request For Proposals and more serious consideration given to alternate proposals. Contractors should be encouraged to submit alternate proposals that define cost deltas and risks for requirements they consider to be cost drivers. Also, alternate approaches to field support, such as interim contractor support, until support equipment can be in place and operating, or full contractor support for an indefinite period should be proposed. Planning must include a careful analysis of the timing of the changeover to full organic support.

During the team's travels, it was found that incentives are not a satisfactory substitute for a well defined requirement. Complicated contractual incentives often create difficult problems and generate adversary relationships. Better results could be obtained by concentrating on the requirements. Unfortunately contracting officers spend most of their time working

with their financial and legal advisors and little with their technical support personnel. Reliability Improvement Warranties, or any other warranty provision should be applied only on a selective basis, generally in competitive acquisitions, and require a full understanding of all parties, (user, AFLC, ATC, etc.,) as to the responsibilities of the Government under the terms of the contract. The objective of the Reliability Improvement Warranty can also be achieved by doing a better job of describing the requirements, emphasizing product assurance in the beginning, and requiring the contractor to provide field support.

The AFSC/CC initiative on the use of past performance in source selections will make a significant contribution to the effort to improve product assurance. This effort should continue, and be strengthened, if possible, recognizing that it is not as easy for the Government to make the judgments that a commercial firm can make because of the emphasis placed on low bidders and the fact that, in a protest, the burden of proof would be on the Government. The rating system described under Part V.G. will emphasize the AFSC intent to use past performance to impact future awards.

To further support General Slay's efforts toward program baselining, another initiative that should be implemented, on a selective basis, is deletion of the unilateral right of the Government under the "Changes" article. This would not stop changes, but would require that they be defined and priced before they are authorized. This disciplined approach will help insure that all aspects of the change are evaluated before it is incorporated. This will also emphasize AFSC intention to hold to specification baseline and discourage contractor use of his sustaining engineering force to market changes.

An appropriate program should be selected to test a leasing arrangement similar to the Navy's LEASESAT program. At the very least, AFSC should compare the cost of a leasing arrangement to the cost of the normal acquisition procedure. This could be used on a commercial derivative, such as a mission support or trainer aircraft, ground communication gear, or on a simulator.

It is important to consider, when planning new programs with potential high production volume and low to moderate initial investment, whether substantial savings could be made by keeping two or more firms in the

production phase to maintain competition throughout the program. Authorization to do so presently exists only under Title 10 USC 2304(a)(16), which authorizes negotiation of purchases in the interest of industrial mobilization. Authorization to purchase production items from two sources would maintain competition and could result in increased quality as well as reduced prices.

Clearly there are advantages to be gained by using commercial techniques when appropriate, but there are some cautions that must be observed. First, to gain the advantages of commercial buying some aspects of the commercial environment will have to be provided to the manufacturer. For example, configuration control may have to be left to the supplier so that he has the flexibility to correct deficiencies in a timely manner. Government involvement in Material Review Boards may have to be waived, and responsibility for government furnished components will have to be clearly established between the parties. Most importantly, commercial techniques are not appropriate when pushing the state-of-the-art, or when schedule is legitimately a priority concern.

Secondly, it must be recognized that there are some aspects of the Government environment that conflict with commercial practices, over which AFSC has little or no control. A few of these environmental factors are the annual appropriations process, the requirement for synopsis, the Truth in Negotiations Act, and the requirement to buy from the lowest responsive and responsible bidder. Business strategies must take into account the social and economic programs which are mandatory for Government buying, but which may conflict with sound commercial practices.

Thirdly, commercial warranties will not go very far toward preventing or resolving our product assurance problems. Generally they cover only materials and workmanship, for a specified time, and would have been of little value in the solution of the quality problems experienced in the last few years with AFSC programs. A notable exception is found in the case of commercial transport aircraft. Warranties for these aircraft do include a provision that permits design changes to correct problems. In other cases, commercial firms will correct design problems because of product liability, customer or consumer pressure, to assure future business, but not just because of their legal obligations under the written warranty.

In summary, the contract document must be put in its proper perspective. It will not make an airplane fly or an engine run. Management attention to product assurance and properly defined specifications are the most important influences toward improved quality and reliability. Warranty clauses or other special contract provisions are only tools to assist in obtaining improved products. Still, the Command can, and should, improve its contracting techniques to emphasize commercial procedures, where they can be sensibly used. A handbook, published by AFSC, containing commercial techniques, including warranties, will facilitate compliance with AFSC policies and assist in the goal of better quality products at reasonable prices.

G. Motivation

Although the Quality Horizons' team looked at motivation techniques at various places visited and found few that have endured; the team did discover that many of the tools already available to AFSC are not being used to full advantage. In many cases, Systems Command policy already clearly indorses the motivation techniques discussed in this section. Detailed criteria and instructions, or better information, are needed to more effectively implement Command policy.

AFSC should place more emphasis on the withholding of progress payments when a contractor is not living up to his contract promises, and withhold acceptance of items that do not conform to contract requirements. Specific criteria should be established and promulgated through policy letters or regulations, as determined appropriate by AFSC/PM. There must be a clear demonstration to industry that AFSC will no longer permit quality to be subordinated to schedule. In competitive programs, consideration should be given to omission of the progress payments provision to encourage timely delivery of a quality product.

Programs should be selected to implement a limited time, failure free warranty provision which would allow for final acceptance of a product after 60 or 90 days of field use. The contractor would be responsible for correcting all failures during the warranty period prior to acceptance and payment. Such an approach would also have the built-in advantage of providing timely and accurate failure data for the contractor's analysis which would facilitate corrective action based on knowledge of the inherent failure modes.

The cost of money to support this planned delay in payment would have to be recognized, but the use of the technique would increase the level of attention to product assurance and thus be a very worthwhile investment.

There is almost universal agreement in the U.S. defense industry that the award fee technique is effective as a motivator. Attention to product assurance disciplines in award fee plans will result in more effective and concentrated front end efforts. Award fee contracts are being used extensively, and this use should continue. Product assurance emphasis in award fee plans should be enhanced by the organizational changes recommended. The AFSC "Guide to Award Fee" should be modified to provide guidance in the use of award fees to achieve product assurance objectives.

Contractor rating or "experience" lists have been difficult to sustain in AFSC's acquisition environment, and past performance reports could not be used as an exclusive criteria in source selection. Such a system would, however, make the buying activity aware of potential problems and risks of doing business with a particular source. This information could be used in business strategy, source selection, and other related planning forums.

The rating system should also incorporate positive incentive aspects, for example, a program of recognition through publicity, and eventually through selective withdrawal of Government surveillance, for firms demonstrating a high level of attention to quality and sustaining a record of delivery of supplies conforming to all contract requirements.

Regarding motivation programs for individual workers, the Human Resources Laboratory (HRL) in coordination with union leaders, should evaluate the need for a general program that could be tailored by contractors to their individual requirements. If the need is validated, a program should be created and implemented, to encourage contractors to recognize and reward individual worker quality performance.

H. Government Involvement/Surveillance

The various governmental approaches to contractor surveillance emphasize a disciplined, systematic program to assure that the contractor performs to contract

requirements and delivers an acceptable product. The FAA's approach emphasizes maximum attention on defining the requirements and ensuring that the contractor fully understands them. After the contractor develops an acceptable plan and verifies his capability to perform to it, the FAA reduces their presence in the contractor's plant to the minimum number of representatives required to monitor the contractor's compliance through statistical sampling techniques.

The Army (DARCOM) and the Navy (NAVMAT) also put their emphasis on developing thoroughly defined requirements early in the acquisition life cycle. Their product assurance approach ensures that design requirements are developed and the proper controls established by the contract administration offices. To perform these controls, the NAVPROs are currently implementing a reduced verification technique through their Quality Assessment Program to monitor contractors with fewer people. While the Army performs some of their own contract administration, they rely primarily on DCAS for this function. Both the Army and DLA use the quality assurance evaluation procedures contained in DLAM 8200.1 (similar to AFCMDR 74-1).

DCAS is presently testing their Contractor Assessment Program approach to assure contractor compliance to established Government program requirements. This approach requires the contractor to accept more responsibility for product quality by performing more of the assurance tasks that previously were accomplished by the Government Quality Assurance Representative (QAR). Although there is limited CAP data available, contractor and DCAS representatives in the test program maintain that CAP is effective in attaining product quality with minimum Government involvement.

AFCMD's contractor surveillance approach is implemented through the Contractor Management System Evaluation Program (CMSEP). AFPROs use CMSEP to verify contractor compliance to the aggregate of contract requirements at each plant established by various program offices through a management systems approach. AFPRO functional divisions are aligned parallel with the contractor's, and each division monitors that functional area for all contracts. This approach relies on condition questions (management system indicators) to verify the existence and adequacy of the contractor's written instructions, worker compliance with those instructions and product inspection. The QA function uses this approach for

verification of both management and work instruction procedures. However, the verification effort of CMSEP is only as good as the specific product requirements established by each program office. More structured and disciplined procedures must be developed and implemented to establish contract technical requirements and assure the coordination of those requirements with the contract administration office. These procedures must assure the complete understanding of the technical requirements that need special attention due to criticality or risk by product assurance personnel at all levels. Data accumulation and reporting procedures must be improved to enhance communication between each product assurance organization. Individual "lessons learned" must be collected and disseminated to all organizations to prevent problems encountered and solved at one organization from occurring at another. New methods and procedures found effective at one organization should be made available to others for consideration. Each product assurance organization must accumulate the technical expertise necessary to support the program manager and engineering staff in assuring that the desired reliability, corrosion prevention, system safety, producibility, inspectability, standardization, and maintainability requirements are attained. Product assurance personnel must assure that trade-off studies are conducted. Assessments should be made in selected instances to verify contractor product assurance involvement in the internal design process. Emphasis should be directed toward the contractor's performance of product assurance tasks with Government review of the verification data.

The recommended approach to product assurance surveillance of the contractor's contract compliance is the Minimum In-Plant Surveillance (MIPS) Program. The purpose of MIPS is to shift the nature of plant-level activity away from conformance verification, toward prevention, and to reduce the overall depth of surveillance in line with contractor product assurance performance. Any decrease in surveillance must be based on objective data and on-site analysis to determine the degree of excellence sustained by the contractor. Guidelines for reducing conformance verification effort should be included in implementing directives. Procedures must also be developed for program office concurrence in MIPS evaluations. In addition, the contractor should be encouraged to make formal application for reduced Government surveillance. Special care must be taken to provide for a fair and equitable consideration of the contractor's application.

The nucleus of the MIPS program should include:

1. Criteria that must be achieved for contractors to make application for reduction of Government surveillance.

2. The data and format the contractor's application should include.

3. The delegation of the approval of the contractor's application to the AFPRO and the program office product assurance representatives.

4. An appeal procedure that permits the contractor to request further review of a disapproved application by the AFCMD Commander and the Program Manager.

The MIPS program incorporates the optimum mix of the various reduced surveillance programs observed by the Quality Horizons' Study Team such as the FAA's Quality Assurance System Analysis Review (QASAR) and Designated Manufacturer Inspection Representative (DMIR) programs and DLA's Contractor Assessment Program (CAP). The MIPS program also recognizes that detection of nonconformances and in-plant problems does not appear to be manning sensitive. In other words, nominal increases or decreases in CAO quality assurance personnel in-plant does not appear to result in a significant change in the number of nonconformances found by Government inspectors. There is an obvious decrease in nonconformance detections when manning is reduced below an undefined threshold level where the number of inspections actually performed is very low or zero. The MIPS program would also capitalize on the contractor's intrinsic motivation to achieve greater internal control of manufacturing and inspection operations through the relaxation of government verification activities.

The product assurance representatives of the program office, the prime contractor and the AFPRO must assure that methods and procedures are developed for attaining adequate government surveillance at subcontractor's plants. The Government representatives at the subcontractor's plant must understand the extent and method of their involvement in support of the acquisition. Government source inspection requirements must be mutually developed and included in formal Memorandums of Agreement (MOAs) or Letters of Instruction (LOIs).

There also must be a special effort to take advantage of new and improved quality technologies through the AF Laboratories. Procedures need to be developed that will promote the distribution of the new and improved techniques to all AFSC product assurance organizations. The AFSC quality technology (Q-TECH) program must complement the AFSC Man-Tech program. Some of the new or improved techniques may require the development of training courses to improve the capabilities of the personnel assigned to the product assurance organizations. If training is required, it should be developed and scheduled on a priority basis.

I. Life Cycle Product Assurance

The interviews, studies, and analyses accomplished by the Quality Horizons Team convinced the members that certain actions are necessary to improve product quality and that quality will improve if these actions are taken.

Top management attention to quality, and the willingness to sacrifice schedule to achieve it, is a must. A disciplined approach to planning, utilizing the assurance disciplines, is common to all successful programs. Also common to many organizations, both commercial and government, is the trend toward organizational change to recognize the interrelated aspects of the assurance disciplines and give them the potency of an integrated, top level organization. The combined effect of the foregoing is a front end emphasis on quality that may not eliminate, but will minimize, surprises in the field environment.

Contracting techniques need to be improved. There are commercial techniques that should be used in more AFSC procurements. Improvements in business strategy planning, in the direction of product assurance, should be made. A better job of motivating the producer can and should be done, both through contractual provisions and other programs.

As the recommended programs begin to take hold, and reduced government surveillance becomes possible, additional manpower can be applied to the front end efforts to increase quality, and the program will gain momentum toward the proper balance of product assurance throughout the life cycle. Only through continuous involvement throughout the life cycle can AFSC assure the delivery of top quality products to the using commands.

Figure 10 lists the major systems acquisition tasks to be performed by the new product assurance organization and illustrates when these tasks should be performed in the life cycle. This Figure is not intended to be all inclusive nor totally precise. Further refinements will have to be made after the new organization is established. However, the intent is to show that HQ AFSC must orchestrate a systematic life cycle approach to make the concept viable.

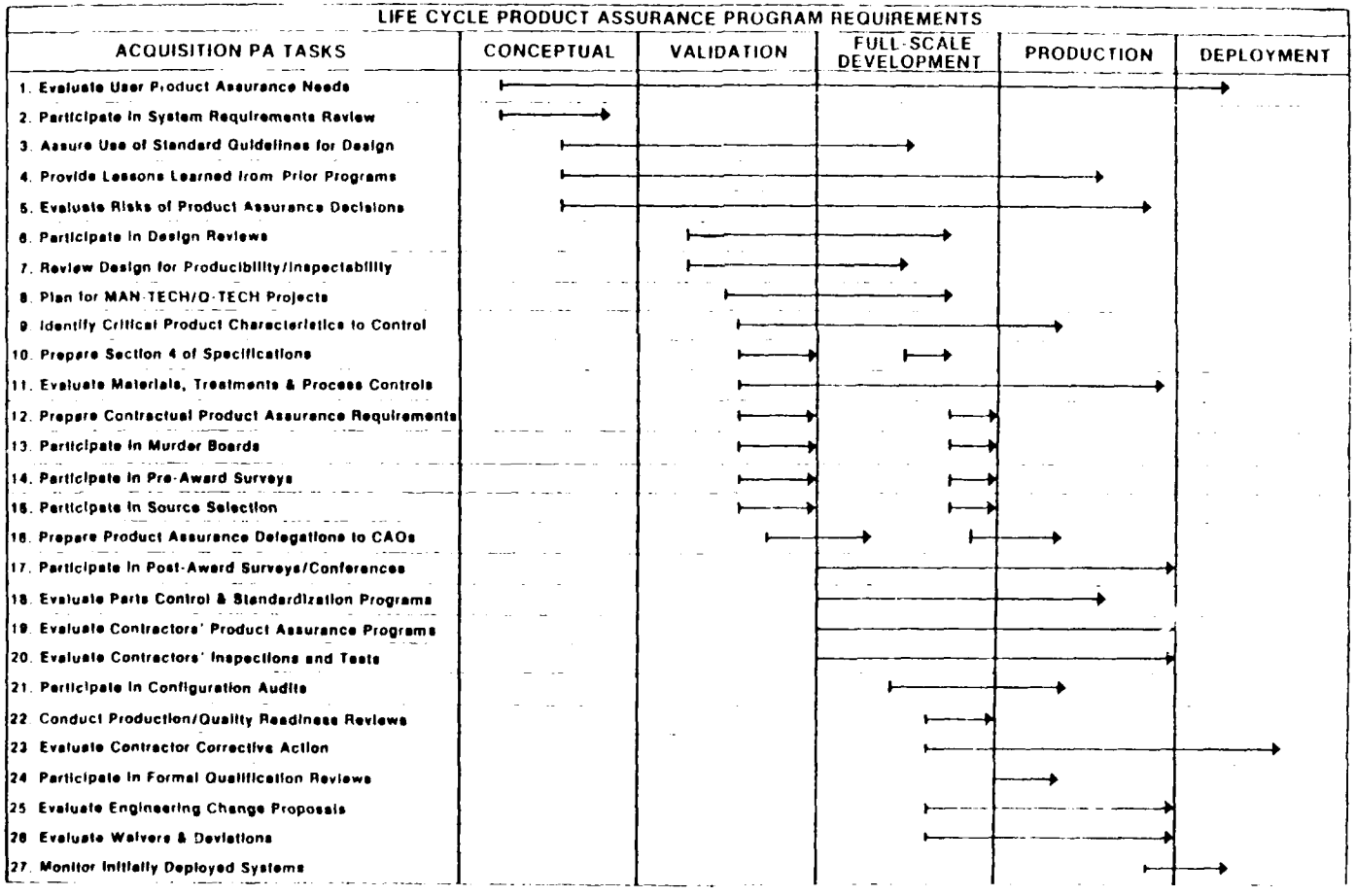
LIFE CYCLE PRODUCT ASSURANCE PROGRAM REQUIREMENTS
ACQUISITION PA TASKS
CONCEPTUAL
VALIDATION
FULL-SCALE DEVELOPMENT
PRODUCTION
DEPLOYMENT
1. Evaluate User Product Assurance Needs
2. Participate in System Requirements Review
3. Assure Use of Standard Guidelines for Design
4. Provide Lessons Learned from Prior Programs
5. Evaluate Risks of Product Assurance Decisions
6. Participate in Design Reviews
7. Review Design for Producibility/Inspectability
8. Plan for MAN-TECH/O-TECH Projects
9. Identify Critical Product Characteristics to Control
10. Prepare Section 4 of Specifications
11. Evaluate Materials, Treatments & Process Controls
12. Prepare Contractual Product Assurance Requirements
13. Participate in Murder Boards
14. Participate in Pre-Award Surveys
15. Participate in Source Selection
16. Prepare Product Assurance Delegations to CAOs
17. Participate in Post-Award Surveys/Conferences
18. Evaluate Parts Control & Standardization Programs
19. Evaluate Contractors' Product Assurance Programs
20. Evaluate Contractors' Inspections and Tests
21. Participate in Configuration Audits
22. Conduct Production/Quality Readiness Reviews
23. Evaluate Contractor Corrective Action
24. Participate in Formal Qualification Reviews
25. Evaluate Engineering Change Proposals
26. Evaluate Waivers & Deviations
27. Monitor Initially Deployed Systems

FIGURE 10

VI. IMPLEMENTATION

Many of the industry executives interviewed by the Quality Horizons Study Team expressed an attitude that things will not change in the government contracting arena. While they were supportive of the study objectives, they did express concern that the findings would not be accepted nor the recommendations implemented. They felt that the team would not be able to generate enough emphasis to overcome the inertia of the bureaucracy. Therefore, it is most important that AFSC/CC implement selected changes and give those changes the widest possible publicity, perhaps through a video tape discussion. This would be a positive motivator, not only for product assurance, but for other AFSC initiatives. In addition, a letter should be sent to the field commanders to implement the product assurance program, and emphasize that schedule may be traded-off for quality, reliability and/or user needs.

The Quality Horizons Report identifies new and revitalized approaches to enhance the product assurance of hardware in the hands of the user. Essential to the successful outcome of many of these recommendations will be the continuous implementation, tracking and follow-up of the action line items presented in Appendix I (Action Plan) of this report. Following the consideration of these recommendations by the AFSC Council, and selection of those to be implemented by the Commander, it is recommended that a General Officer Steering Group (GOSG) be formed including both field and Headquarters members, to meet and track progress on a quarterly basis for the first year and semi-annually thereafter. The Commander, AFSC should be given progress reports within 15 days after each GOSG meeting.

It is recommended that this joint GOSG be made up of persons occupying the following positions:

a. AFSC/CV (Chairman)

b. DCS/Systems, Hq. AFSC

c. DCS/Contracting and Manufacturing, Hq. AFSC

d. Commander, AFCMD

e. A Program Manager from a major weapons system program to be selected by AFSC/CC.

The Chief of the Quality Assurance Office, Hq AFSC (PMN) will function as the permanent secretariat and recorder for this GOSG, and a member of the Quality Horizons Study Team should serve as an advisor.

To continue the line of communication with representatives of key industrial associations, it is recommended that a representative from the National Security Industries Association and one from the Aerospace Industries Association be designated as advisors to this group and participate in appropriate sessions. It is further recommended that one of these representatives have a strong background in Product Assurance and the other in the Contracts area.

A P P E N D I C E S

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APPENDIX 1

ACTION PLAN

QUALITY PLANNING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION*
1.1	Product Assurance Regulation	Develop a composite AFSC Regulation that defines the integrated tasks and inter-relationships among the functional disciplines required to implement the product assurance concept and stress preventive efforts early in design rather than through emphasis or conformance inspection during production.	V.B.	AFSC/SD	AFSC/PM	6 months
1.2	Corporate Memory Handbooks	Develop AFSC handbooks that provide specific guidance for tailoring and applying the available tools and techniques in each of the functional disciplines listed below. This guidance will include the benefits provided by these tools and techniques as well as the risk of omitting them and cost trade-off guidance. The OPRs will act as command focal points in assuring that lessons learned are incorporated in revisions.	V.B.			
		Quality Assurance		AFCMD/QA	ESD/TO	9 months
		Reliability		ESD/RADC	SAMSO/MN	9 months
		Maintainability		ASD/EN	ADTC/SD	9 months
		System Design Safety		ASD/SE	ADTC/SE	9 months
		Corrosion Prevention		AFML	ASD/EN	9 months
		Manufacturing		ASD/PM	ESD/TO	9 months
		Standardization		SAMSO/LG	ASD/AW	9 months

*After action item approval by AFSC/CC

ACTION PLAN (Continued)

GOVERNMENT INVOLVEMENT/SURVEILLANCE

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
2.1	Introduction to Product Assurance	Develop a briefing to present the concept of Product Assurance to AFSC Product Divisions, AFCMD, HQ DLA and NAVMAT. Briefing to include definition of Product Assurance, Quality Horizons Observations, and approved recommendations; e.g. MIPS. Emphasize prevention tasks by Program Office and specific support required of CAO, and the interrelationships between these organizations.	V.B.	AFSC/PM	AFSC/SD	5 months
2.2	Introduction to Product Assurance	Present the briefing.	V.B.	AFSC/PM	AFSC/SD	12 months
2.3	Minimum In-Plant Surveillance Program	Develop an AFSC regulation to establish the MIPS Program. The program will provide criteria and procedures for contractors to apply for reduced in-plant surveillance by supplying objective data of sustained quality performance. AFPRs/SPOs will have approval authority. Contractors may escalate adverse decisions to AFCMD/CC and program managers.	V.H	AFSC/PM	AFCMD/QA	6 months
2.4	Minimum In-Plant Surveillance Program	Implement program by AFSC/CC letter to contractor top management to motivate contractor to apply for MIPS.	V.H.	AFSC/PM	AFCMD/QA	7 months

ACTION PLAN (Continued)

ORGANIZATION

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
3.1	Product Assurance Organization	Combine product assurance disciplines (e.g. reliability, maintainability, quality, corrosion control, standardization, system safety, manufacturing) into one separate staff organization at HQ AFSC, AFCMD, AFPROs, Product Divisions and Program Offices. The new organization is to report to the Commander. Revise organization and functions documents and applicable position descriptions.	V.C	AFSC/MO	AFSC/PM	6 months
3.2	Alternate Product Assurance Organization	If the above action is not supported implement two phased reorganization. Phase I - Combine product assurance disciplines at HQ AFSC to gain field attention and emphasize the need for enhanced product quality through design efforts. Withhold further implementation pending evaluation as to whether reorganization at field activities is necessary to achieve the proper attention to product assurance and to institutionalize concept. Phase II - Combine disciplines at Product Divisions/AFCMD as determined by evaluation results of Phase I.	V.C.	AFSC/MO	AFSC/PM	Phase I 6 months Phase II 18 months

ACTION PLAN (Continued)

MANNING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
4.1	Initial Manning for Product Assurance	Identify AFSC manpower performing product assurance functions. Transfer manpower to new organization at HQ AFSC, AFCMD, AFPROs, Product Divisions and Program Offices if Action Item 3.1 is approved. If Action Item 3.2 is approved transfer manpower at HQ AFSC only. Transfer manpower at other organizations based upon evaluation and decision reached as a result of Action Item 3.2.	V.D.	AFSC/MO	AFSC/DP	6 months if Action Item 3.1 is approved. 6 months for HQ AFSC if Action Item 3.2 is approved and 18 months for other organizations.
4.2	Policy Statement on Contracting-Out	Issue Policy Statement to encourage contracting-out for those product assurance skills not available in AFSC.	V.D.	AFSC/PM	AFSC/JA/MO	8 months
4.3	Re-allocation Study	Study Product Assurance manning levels and tasks to determine optimum levels of manning at HQ AFSC, Product Divisions, and AFCMD.	V.D.	AFSC PMAG	AFSC/MO	9 months
4.4	Personnel Transfer Plan	Develop and implement plan to transfer personnel to achieve optimum manning levels in accordance with Action Item 4.3.	V.D.	AFSC/DP	AFSC/PM	8 months develop plan. 18 months to complete implementation.

ACTION PLAN (Continued)

EDUCATION/TRAINING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
5.1	Intern Program	Develop, provide manpower for and implement a formal intern program to provide continual source of qualified personnel. Program to provide 3 years of formal and on-the-job training and output a minimum of 25 graduates per year.	V.E.	AFSC/DP	AFSC/SD/PM	10 months
5.2	Educational Levels	Determine the educational level of the contractor's product assurance organization where there is an AFPRO. Establish a goal of educational comparability between AFPRO and contractor. Develop plan to achieve this goal.	V.E.	AFCMD/QA	AFSC/PM	9 months
5.3	Workforce Training	Determine skills necessary to accomplish product assurance functions. Inventory skills existing in workforce. Develop and implement formal training program to upgrade and maintain required skills.	V.E.	AFSC/DP	AFSC/PM	6 months
5.4	Contracting-Out Training	Evaluate training programs and capabilities available within DoD and contract-out for those which are unavailable.	V.E.	AFSC/DP	AFSC/PM	9 months

ACTION PLAN (Continued)

EDUCATION/TRAINING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
5.5	Top Management Training	Assure that Product Assurance Training is included in Professional Military Education programs and other executive courses. Training objectives to emphasize Product Assurance benefits and risks due to omission of Product Assurance tasks.	V.E.	AFSC/DP	AFSC/PM	9 months
5.6	Education With Industry (EWI)	Study the benefits of establishing an EWI pprogram for both civilian and military personnel in product assurance and consider expanding the total EWI program to include civilians. Establish program if warranted.	V.E.	AFSC/DP	AFIT/CI	18 months
5.7	Civilian Career Program	Develop an AFSC regulation to establish a product assurance career program to provide for career counseling, appraisal and progression (similar to the Procurement and Manufacturing Civilian Career Development Program, AFSCR 50-5).	V.E.	AFSC/PM	AFSC/DP	12 months

ACTION PLAN (Continued)

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.1	"Changes" Clause	To further support and emphasize AFSC/CC policy regarding baselining, prepare a modified "Changes" Article, omitting the unilateral right to make changes. Obtain ASPR deviation to permit trial use. Include modified clause in selected contract(s) to emphasize government intention to hold to specification baseline and discourage contractor use of sustaining engineering force to market changes.	V.F.	AFSC/PM	AFSC/JA	7 months
6.2	Field Acceptance	Develop provisions for equipment acceptance at the operating location after field use - i.e. 30, 60, or 90 days. A short term failure free warranty to assure operational suitability. Select candidate programs and implement.	V.G.	AFSC/PM	AFSC/JA	12 months
6.3	Progress Payments Omission	Select competitive programs at each Product Division for omission of Progress Payments clause. Omit clause in selected programs to encourage timely delivery of quality products.	V.G.	AFSC/PM	AFSC/JA	8 months
6.4	Progress Payment Withholding	Establish criteria for withholding of Progress Payments with emphasis on Product Assurance problems, and publish as AFSC policy.	V.G.	AFSC/PM	AFSC/JA	4 months

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.5	Dual Sourcing	Establish criteria for programs with potential savings if production dual sourced; such as high volume items requiring low to moderate capital investment. Select candidate programs and request SAFGC/SAFAL interpretation for negotiation authority (other than 10 USC 2304(a)(16) (Industrial Mobilization) to continue at least two sources into production. Implement program.	V.F.	AFSC/PM	AFSC/JA	10 months
6.6	Motivation Program	Evaluate the need for and develop in co-ordination with union leaders and Human Resources Lab, an umbrella motivation program that could be tailored by contractors to their individual requirements. Contractors would be encouraged to recognize and reward worker quality performance.	V.G.	HRL	AFSC/PM AFCMD	15 months
6.7	Award Fee	Develop Award Fee policy to recognize Product Assurance as an element of Award Fee plans. Modify AFSC "Guide to Award Fee", PMPS, Dec 77, to include specific examples for the use of Award Fees to motivate enhanced product quality throughout the acquisition cycle.	V.G.	SAMSO/PM	ASD/PM	3 months

ACTION PLAN (Continued)

CONTRACTING

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
6.8	Leasing	Select candidate programs where commercial leasing techniques or lease-purchase arrangements would be appropriate (i.e. simulators, trainer aircraft, etc.). Implement the program; collect and publish lessons learned.	V.F.	AFSC/PM	AFSC/JA	12 months
6.9	Commercial Warranties/ Practices	Prepare handbook containing commercial contracting techniques, negotiation strategy and tactics, and criteria for application of the clauses, warranties and techniques. Purpose of the handbook is to facilitate proper use of commercial techniques and to promote, with specifics, current AFSC policy.	V.F.	ASD/PM	AFSC/PM	6 months
6.10	Business Strategy	Revise AFSCR 70-2 to define Product Assurance considerations so that AFSC can capitalize on commercial approaches to enhance product quality early in the acquisition phase.	V.F.	AFSC/PM	AFSC/SD	4 months

ACTION PLAN (Continued)

TOP MANAGEMENT ATTENTION

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
7.1	Management Emphasis	Include emphasis on product assurance objectives to industry/AFSC top management in next AFSC/CC video tape.	VI.	AFSC/PM	AFSC/OI	9 months
7.2	Management Emphasis	Prepare and distribute AFSC/CC letter to all AFSC field commanders to implement product assurance program and emphasize willingness to trade-off schedule for quality, reliability and customer satisfaction.	VI.	AFSC/PM	AFSC/CS	2 months
7.3	Management Appreciation of Product Assurance Approach	Develop training program and present to top management in all organizations. Training objectives to emphasize product assurance benefits and risks due to omission of product assurance tasks.	V.E.	AFSC/DP	AFSC/PM	12 months
7.4	Program Reviews	Revise AFSCR 800-23 to have Program Managers/AFPRs present product assurance status (accomplishments and problem areas) during PAR/CAR briefings.	V.B.	AFSC/SD	AFSC/PM	6 months
7.5	Program Reviews	Develop and distribute policy guidance using applicable data items and military standards to require contractor presentation of product assurance status during program technical and management reviews.	V.B.	AFSC/SD	AFSC/PM	6 months

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ACTION PLAN (Continued)

MISCELLANEOUS

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
8.1	General Officer Steering Group (GOSG)	Establish a General Officer Steering Group consisting of representatives from HQ AFSC, Product Divisions and AFCMD to provide a balanced view toward Product Assurance. The GOSG will provide direction and track the Quality Horizons Study recommendations selected for implementation by the AFSC/CC.	VI.	AFSC/CS	AFSC/PM	2 months
8.2	Data Systems Guidance	Develop AFSC pamphlet to enhance the use of the product assurance data available in existing Air Force data collection systems e.g. AFM 66-1 data by the program offices and contractors. The pamphlet should identify the type of data, strengths and weaknesses, and the method of obtaining the data in each system.	V.H.	AFSC/SD	SAMSO/MN	10 months
8.3	Quality Technology (Q-TECH)	Establish guidelines for prioritizing Q-TECH projects and funding to assure that Q-TECH remains parallel and abreast of the Manufacturing Technology Program. Disseminate results of Q-TECH projects throughout AFSC.	V.H.	AFSC/PM	AFSC/DL	18 months

ACTION PLAN (Continued)

MISCELLANEOUS

ITEM	SUBJECT	ACTION REQUIRED	REPORT REFERENCE	OPR	OCR	SCHEDULED COMPLETION
8.4	Quality Technology (Q-TECH)	Develop training programs to assure that product assurance personnel remain current with emerging quality technologies.	V.E.	AFSC/DP	AFSC/PM	18 months
8.5	DLA Liaison Offices	In consonance with DLA, establish DLA liaison offices at each Product Division to facilitate communications, problem resolution, and emphasize Product Assurance in design and development phases.	V.C.	AFSC/PM	ESD/TO	12 months

APPENDIX 2

QUALITY HORIZONS STUDY APPROACH

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STUDY OBJECTIVES

- EVALUATE AFSC APPROACH TO QA
- IDENTIFY CHANGES WITH POTENTIAL TO:
  - IMPROVE END ITEM QUALITY
  - MAKE CONTRACTORS MORE RESPONSIBLE FOR THEIR PRODUCTS
  - MAKE MORE EFFECTIVE USE OF RESOURCES
  - APPLY APPROPRIATE COMMERCIAL PRACTICES

CURRENT CONCERNS

- CURRENT TECHNIQUES
  - LITTLE CHANGE IN 20 YEARS
  - AF IN-PLANT PRESENCE HIGH
  - LACK OF STRONG POSITIVE/NEGATIVE INCENTIVES
  - LITTLE APPLICATION OF PROVEN COMMERCIAL PRACTICES
- AFSC QA WORK FORCE
  - NUMEROUS RETIREMENTS PENDING
  - LIMITED EDUCATION
  - NOT KEEPING PACE WITH NEW TECHNOLOGY
- AFSC QA SYSTEM
  - PERHAPS EMPHASIS IN WRONG PLACES-AF INSPECTION NOT ALWAYS THE ANSWER
  - AFSC MANAGEMENT ATTENTION TO QA VARIES
  - LIMITED APPLICATION OF LESSONS LEARNED

KEY STUDY AREAS

- EXAMINE WAYS TO EFFECTIVELY INCENTIVISE CONTRACTORS FOR A BETTER PRODUCT
  - BETTER APPLICATION OF CURRENT TOOLS
  - COMMERCIAL PRIME/VENDOR RELATIONSHIPS
  - RFP, SPECIFICATIONS, PAST PERFORMANCE
  - AWARD FEE, WITHHOLD PAYMENTS
- EXAMINE WAYS TO RESTRUCTURE AF IN-PLANT QA PRESENCE
  - CERTIFICATION PROGRAM
  - COMMERCIAL PRACTICES–FOREIGN & DOMESTIC
  - DLA, FAA, NASA, FOREIGN GOVT EXPERIENCE
- EVALUATE CURRENT QA WORK FORCE AND IDENTIFY NECESSARY CHANGES
  - EDUCATION/TRAINING
  - RECRUITMENT
  - NUMBERS AND SKILLS REQUIRED

KEY STUDY AREAS (CONT'D)

- IDENTIFY REQUIRED POLICY AND ORGANIZATION CHANGES
  - CONTRACT POLICY/MANAGEMENT
  - ROLES OF HQ AFSC, HQ AFCMD, PRODUCT DIVISIONS, IN-PLANT OFFICES AND SPOs
  - PERSONNEL REQUIREMENTS/EDUCATION
  - PRODUCT ASSURANCE (QA + ILITIES) OFFICE
  - AFSC MANAGEMENT ATTENTION TO QA

STUDY ACTIVITIES

- REVIEW PREVIOUS STUDIES AND RECOMMENDATIONS
- VISIT OTHER GOVERNMENT AGENCIES SUCH AS NASA, FAA, DLA, NAVY, ARMY, DOD AND DEFENSE DEPARTMENTS OF GERMANY, NORWAY AND JAPAN FOR IDEAS
- VISIT COMMERCIAL FIRMS IN U.S., EUROPE AND JAPAN IN AUTO, ELECTRONIC, AIRCRAFT, AND OTHER INDUSTRIES TO EXAMINE COMMERCIAL AND CONTRACTUAL PRACTICE/TECHNIQUES
- VISIT DEFENSE AND COMMERCIAL SUBCONTRACTORS TO UNDERSTAND QA INSTRUCTION AND CONTRACTUAL RELATIONSHIPS WITH PRIMES
- VISIT AFIT AND AMETA TO DEVELOP QA EDUCATION PROGRAMS
- UTILIZE INDUSTRIAL ASSOCIATIONS AS A SOUNDING BOARD FOR CONCLUSIONS AND RECOMMENDATIONS
- OBTAIN PRODUCT DIVISION AND AFCMD COMMANDERS' INPUTS ON RECOMMENDATIONS PRIOR TO PRESENTATION TO COMMANDER, AFSC

STUDY TEAM

STUDY DIRECTOR:	COL BERNARD L WEISS, ASD/PM
DEPUTY STUDY DIRECTOR:	ARTHUR A. SHANNON, AFCMD/QA
INCENTIVES/CONTRACT CLAUSES:	LT COL MICHAEL M. MCMILLAN, AFSC/PM DONALD ROBINSON, ASD/PMH
ACQUISITION REQUIREMENTS:	LT COL RICHARD TRACEY, SAMSO/MN
POLICY/REGULATIONS/PERSONNEL:	IRA EPSTEIN, AFSC/PMN
SECRETARIAT:	CAPT RAYMOND R. HONAKER, ASD/PMD CAPT JOHN McNALLY, ASD/PMD

ADVISORS

CONTRACT LAW:	CAPT C. B. GRESHAM, AFLC/JAN
INDUSTRIAL FEEDBACK:	NSIA/AIA COMMITTEES ON QUALITY AND CONTRACTS
QA OPERATING OFFICIALS ADVICE:	PRODUCT DIVISION QA DIRECTORS

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